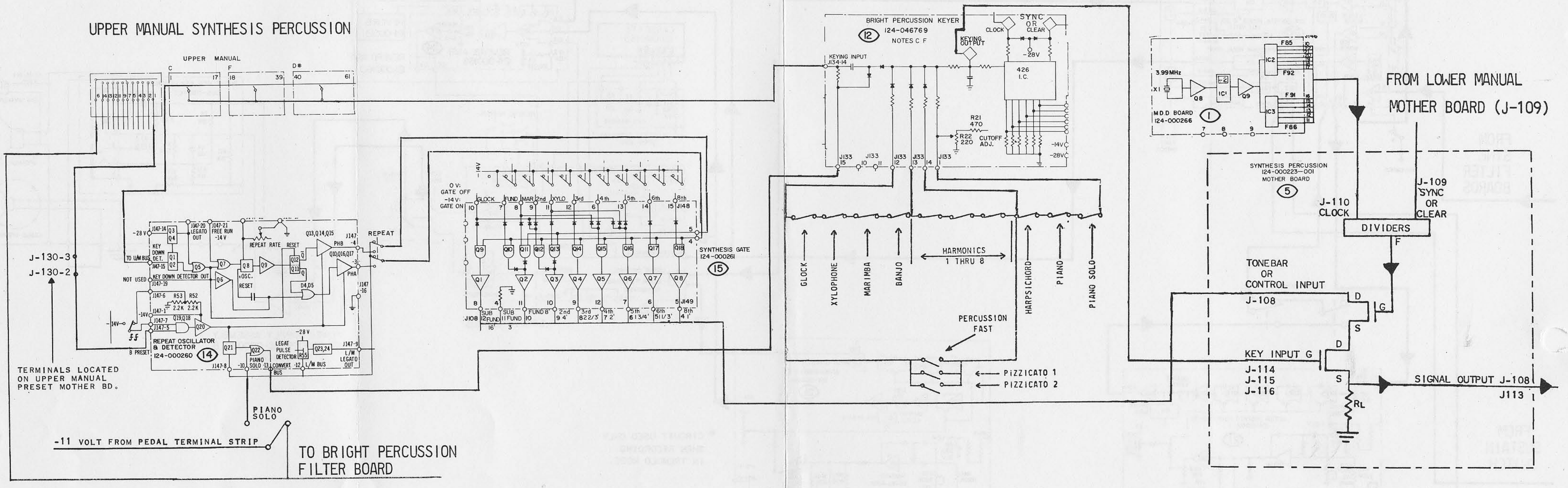
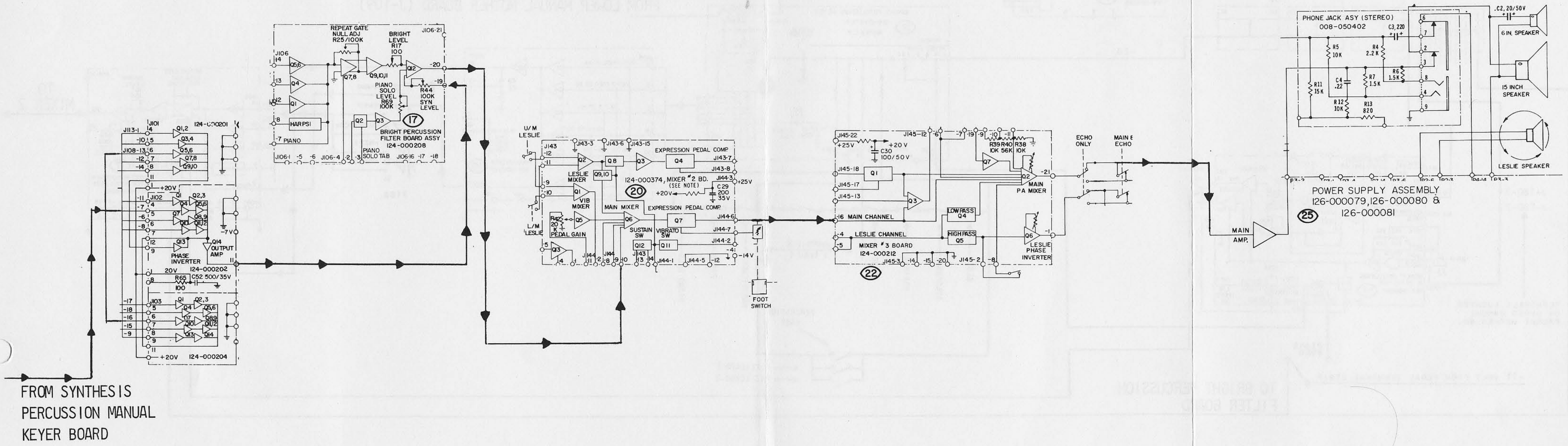
UPPER MANUAL SYNTHESIS PERCUSSION



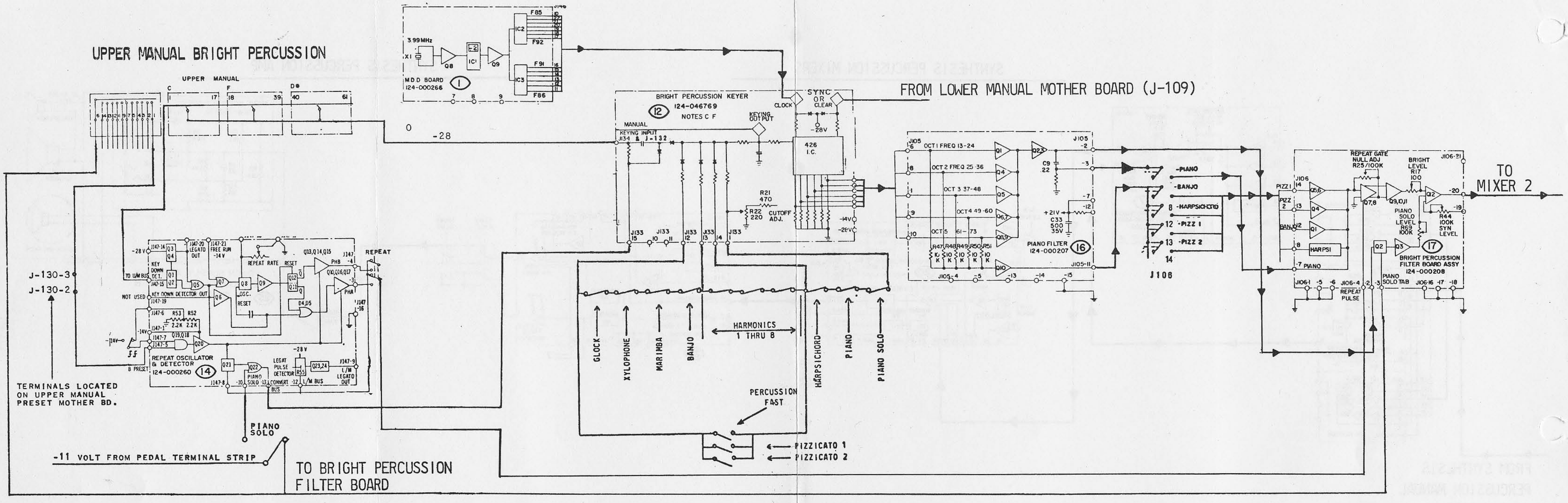
ARROWS INDICATE SIGNAL PATH

SYNTHESIS PERCUSSION MIXERS

SYNTHESIS PERCUSSION AMP

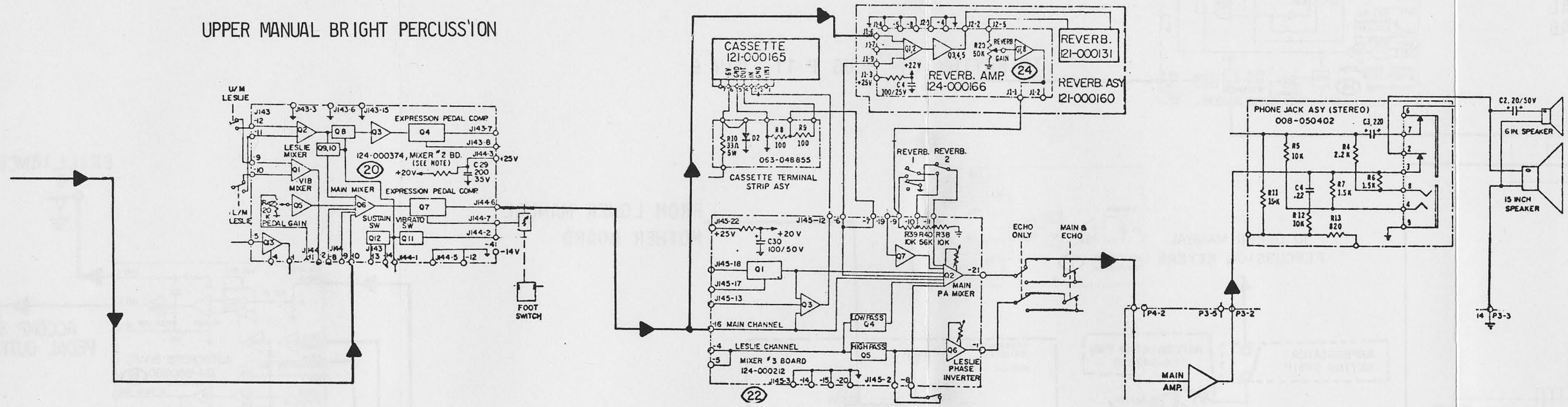


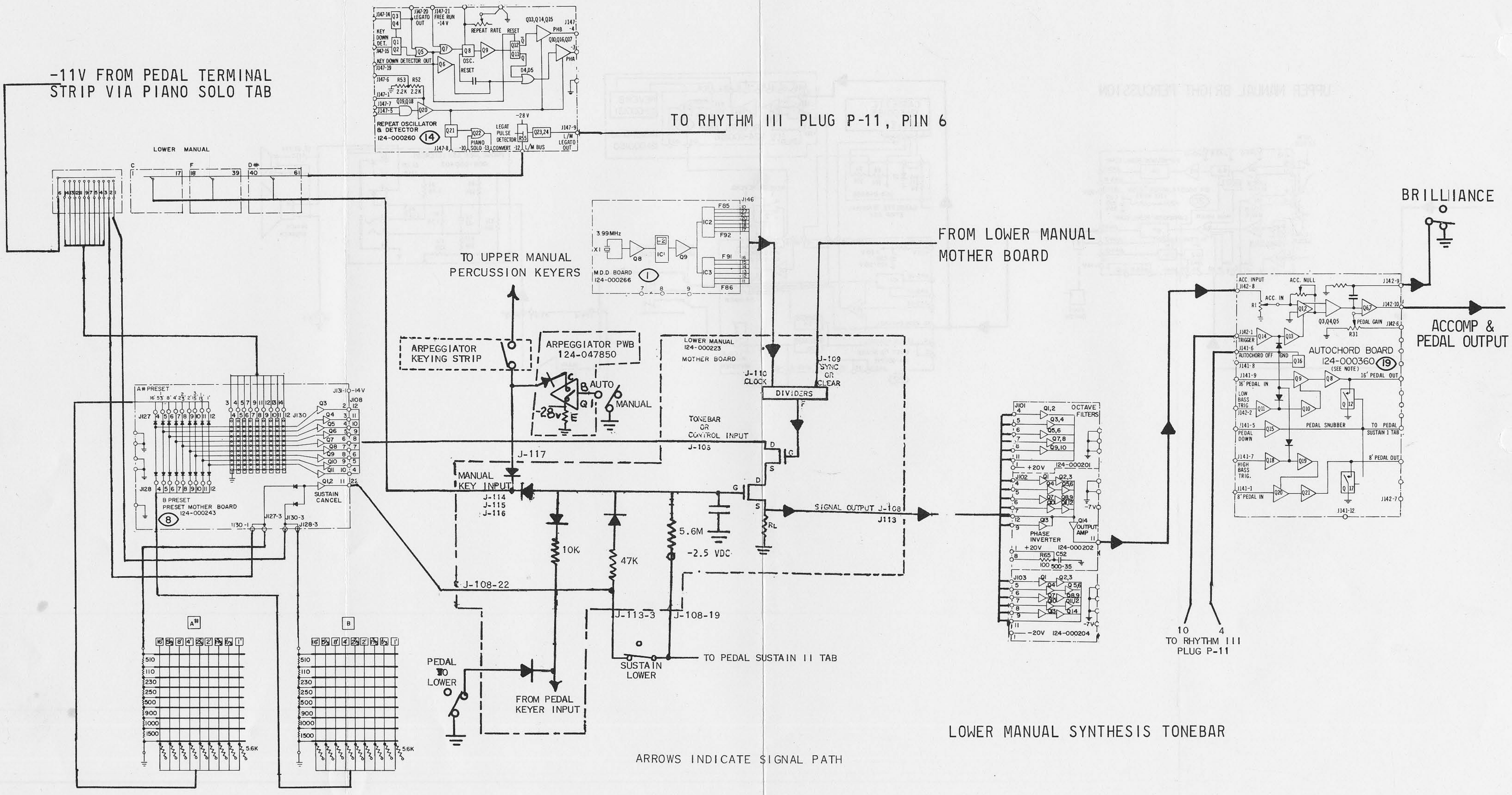
UPPER MANUAL BRIGHT PERCUSSION



ARROWS INDICATE SIGNAL PATH

UPPER MANUAL BRIGHT PERCUSSION



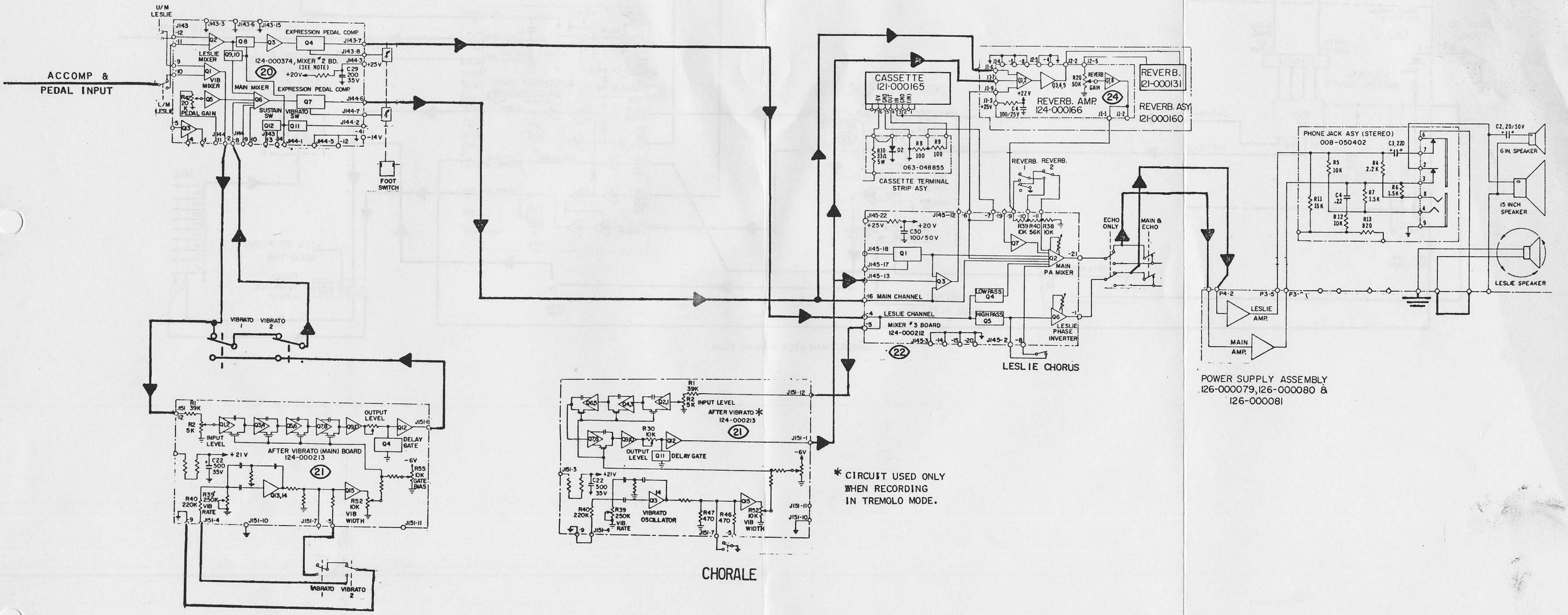


LOWER MANUAL SYNTHESIS TONEBAR

ARROWS INDICATE SIGNAL PATH

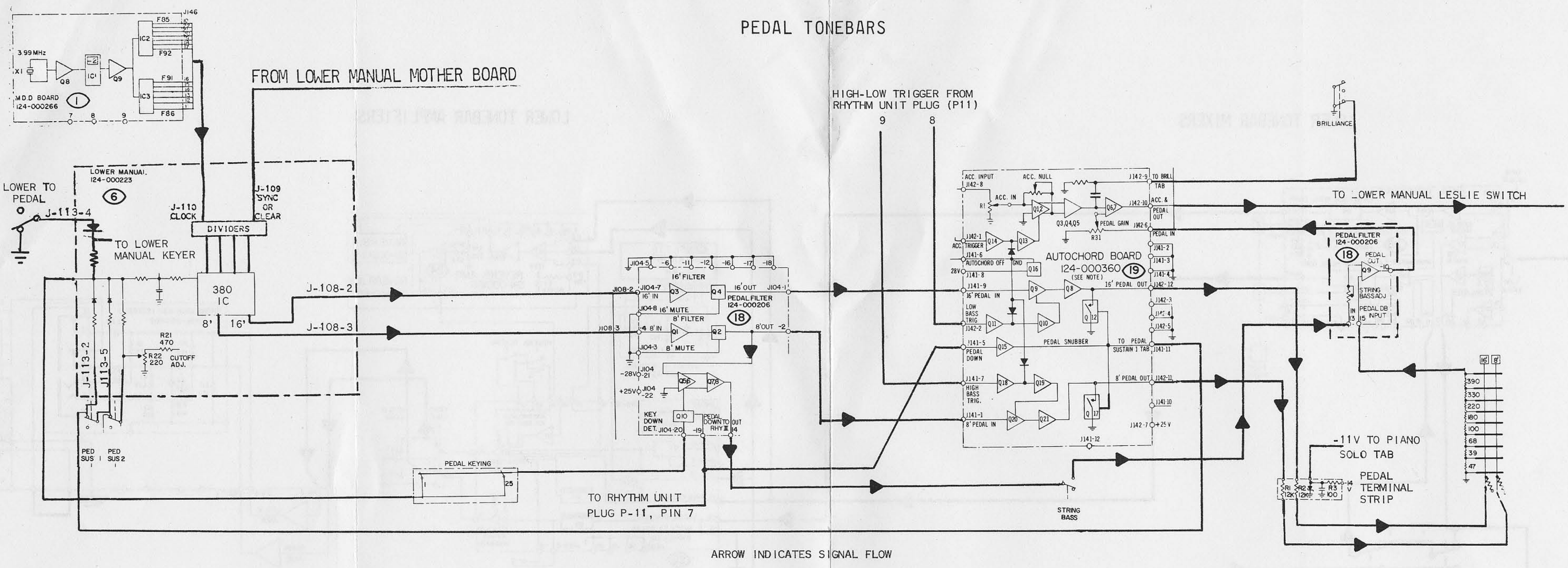
LOWER TONEBAR MIXERS

LOWER TONEBAR AMPLIFIERS

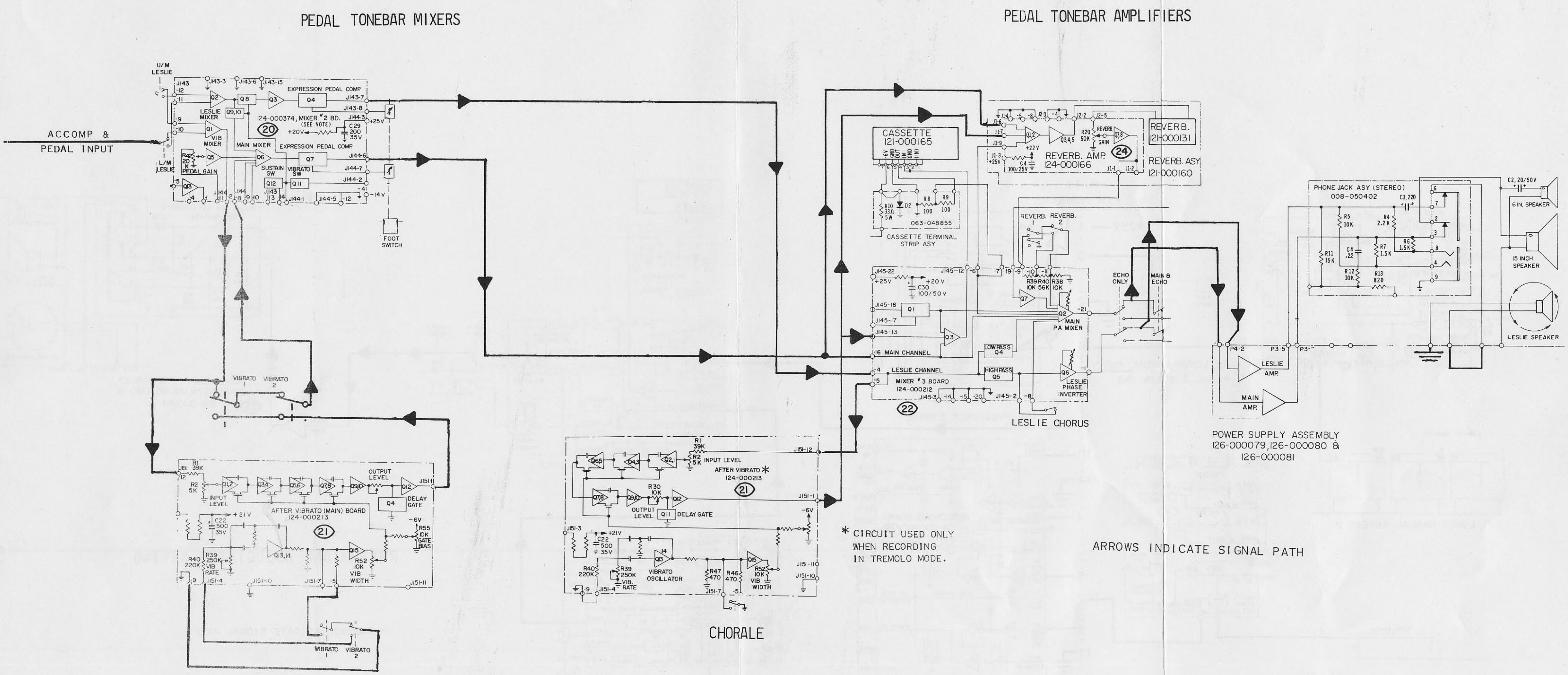


* CIRCUIT USED ONLY WHEN RECORDING IN TREMOLO MODE.

PEDAL TONEBARS



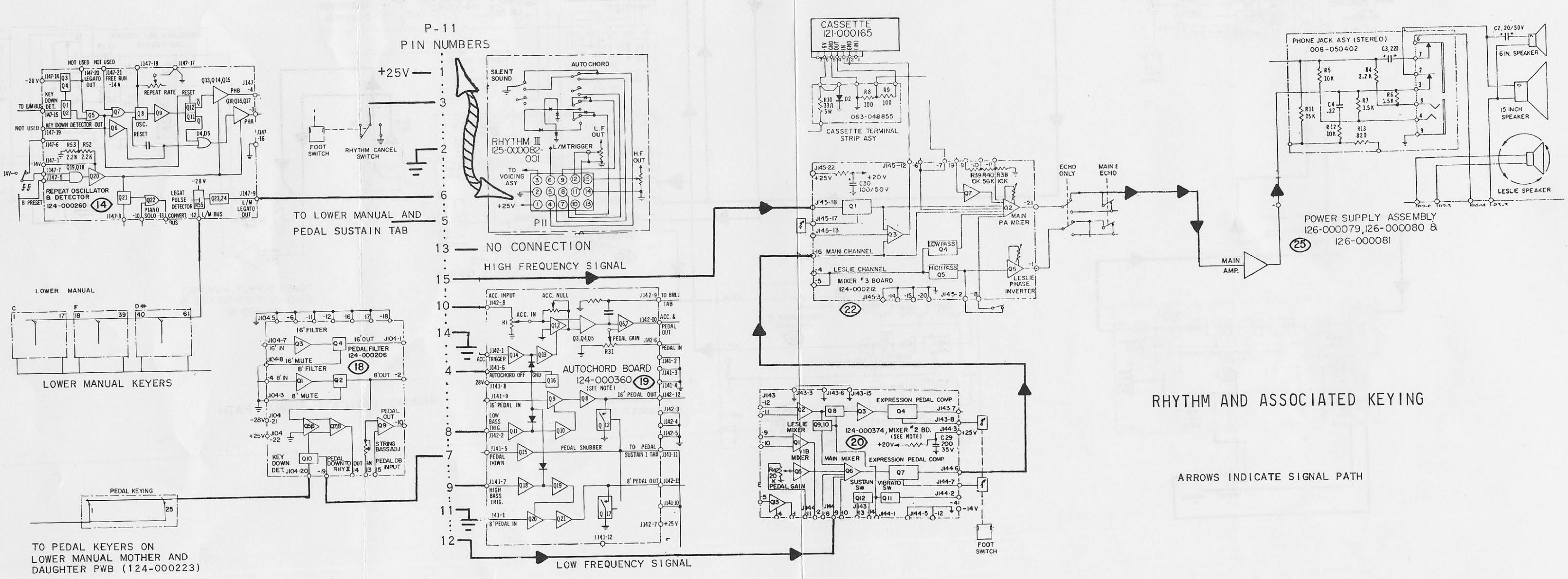
ARROW INDICATES SIGNAL FLOW



* CIRCUIT USED ONLY WHEN RECORDING IN TREMOLO MODE.

POWER SUPPLY ASSEMBLY 126-000079, 126-000080 & 126-000081

ARROWS INDICATE SIGNAL PATH



RHYTHM AND ASSOCIATED KEYING

ARROWS INDICATE SIGNAL PATH

LIST OF ILLUSTRATIONS
2100 SERIES

FIGURE PAGE

LIST OF ILLUSTRATIONS
2100 SERIES

2100 (CONCORDE) THEORY OF OPERATION-SHEET 1 OF 3

1. THE LSIC SYNTHESIS ORGAN

An understanding of MOSFET organ layout including basic theory and related circuit functions is a useful adjunct to service procedure. Referral to detailed schematic diagrams following the text is strongly suggested.

The Concorde is a sine-wave synthesis organ in which a square-wave audio signal from a crystal controlled master oscillator is divided many times into component signals that are subsequently shaped and combined to make musical tones. The Master Oscillator feeds a Multi-Derivative Divider system (MDD) using three LSIC packages to obtain 13 top octave frequencies (square wave) that drive four generator-keyer systems each having up to 13 subsystems (LSIC packages) and associated circuitry.

Each package is called upon to generate all tones from subfundamentals to the highest chosen harmonic of a scale note for five octaves of playing keys. Five top octave or clock frequency inputs drive separate divider chains in each generator-keyer IC producing associated component signals. The thirteenth package handles the 61st note on console manuals (CX or extra C).

Levels of the component signals of complex tones are controlled by varying the DC supply to the keyer circuits through tonebar switches. The LSIC packages provide a single DC input for each key so that several variable level gates can be controlled at the same time. This control of individual harmonics and precise determination of their proportions in tonal mixtures makes available a tremendous variety of musical sounds. Signals are subsequently filtered to sine-wave form, mixed, subjected to envelope control, amplified and converted to acoustic waves by the speakers.

2. TONE GENERATOR

The heart of the tone generator is a crystal controlled Colpitts oscillator consisting of C16, C17, C18, R34, R35, R43, Q8, and X1. It supplies a 3-volt Peak-to-Peak square wave at a frequency of 3.99872 MHZ that drives IC1 of the Multi-Derivative Divider generator (124-000266). The -5volt supply is dropped from -14V (J146-8) by D6 and R36. C15 is used as a high frequency bypass.

IC1, the first signal divider is used to insure a square-wave input signal with a 50 per cent duty cycle to drive the MDD IC packages. Powered by the same -5V source as the oscillator, IC1 drives buffer Q9, supplying an 11 volt 1.99936 MHZ clock frequency for IC2 and IC3. Diodes D10 and D11 protect the clock input gates on the MDD package. IC2 and IC3 are the top octave frequency generators. IC3 supplies square-wave frequencies F86 through F91. IC2 produces a similar wave form at frequencies F92 through F97 and F85. Three power supplies, -11V, -16V, and 28V comes from the organ supply, -16V is provided by two diode drops, D8 and D9 from 14V through R37 to -28V. R40 and R41 form a voltage divider between ground and -14V, providing the -11V supply. (The -11 volt current and the -16 volt supply will draw from 24 ma to 70 ma). Each supply is protected from static discharge by a capacitor (C21, C22, and C23). The 16V supply is filtered by C20. All outputs of IC2 and IC3 are diode-protected from the 16V source by D12 through D24.

The clock frequencies from the MDD generator are supplied to four generator keyer systems via J110. Three are similar:

1. Poly-Synthesis Percussion
2. Lower Manual Synthesis
3. Upper Manual Synthesis

Each system has one (1) 124-000223 type mother board and up to thirteen (13) 380 LSIC's on associated plug-in daughter boards, outputs are square wave. The fourth is called Bright Wave Percussion and consists of two large Self-Contained printed wiring boards, (124-046769 and 001 having a total of six 426 IC's generating stairstep signals.

C Sync

Since the same frequency is used on both manuals and for harmonics of other notes, sync signals are needed to coordinate all the generators, thus locking their signals in phase to prevent cancellation effects. This sync output is obtained from the lower manual synthesis assembly (124-000223) which acts as a master and goes to the other circuits via the sync terminals. (J109) You need both MDD and sync signals to get tones out of the generators.

3. MANUAL & PEDAL KEYBOARDS

Depressing any manual key or pedal makes a single throw, two pole contact which provides keying voltage (-28V DC) to activate a separate IC keyer. This keyer gates an appropriate frequency produced on the MDD Generator (124-000266). Regarding the Upper Manual, the following sequence of events Occurs: From the MDD, signals to J110 on mother board (124-000223-002) then to proper daughter board (124-000256). On each daughter board, the "380" IC provides all octaves and harmonics of one note letter on one manual; such as: all harmonics of all D notes on the upper manual. This requires three clock inputs per IC. The inputs are 1) Fundamental, 2) Third Harmonic, and 3)Fifth Harmonic. Frequency divider chains, inside the IC, divide these down to the required frequency. In order to keep the third and fifth harmonic clocks within the same top octave for all notes, there are two clock inputs for these harmonics, one above and one below the fundamental. Only one of these is used for a particular note. As described in 2), a master sync pulse output obtained from the lower manual synthesis assembly (124-000223) is used to lock together frequencies used on both manuals and as harmonics of several notes on the same manual, to prevent cancellation. This sync pulse is directed to other circuits via J109. When sync output is missing, the odd harmonics (Black Tonebars) usually will not sound. The tonebar inputs (J108) come from the tonebar stop switches via the preset Mother board. This negative DC voltage adjusts the keyer supply voltage and thus the square-wave output current.

Because the ouputs of the manual keyers are square waves, they must be filtered to produce the desired sine-waves. To minimize the interaction between keyers feeding into the same filter, the input impedance of the filter is 100 ohms or less. Therefore, the output voltage at the filter terminals (J108 and J113) is very low when the filters are connected. Sustain effects are achieved by forward (0V) or reverse (-14V) biasing diodes in series with the sustain resistors on the daughter boards via sustain busses on J108 and J113. Pedal sustain comes directly from labeled switches on the control panel. MANUAL sustain works only on the tonebar presets, controlled through the preset Mother board, (124-000243). A keyer cut off control near J117 adjusts the delay limit of the keying voltage during sustain. An extra C note daughter board (C97) is provided to supply the top C on the pedals and C25 and up on the manuals. To prevent sync problems, the C sync signal is taken from the C85 board and is differentiated by a separate transistor on the lower manual mother board so it can be used to sync both "C" dividers. On the upper manual synthesis mother board (124-000223-002), J114, J116, and J117 are marked with key numbers. From these terminals, square-wave outputs go to filter groups F1 through F14 where voicing functions begin. (Sine Filter PWB's 124-000201-202-204).

The lower manual synthesis assembly (124-000223) is similar in function with the addition of the auto-accompaniment provision and production of pedal signals. J11 and J112, (on lower manual synthesis mother board) are square-wave outputs from daughter boards (124-000193) to pedal filter board. (124-000206)

4) PERCUSSION

A. GENERATORS AND KEYERS

Voices originating from either the Bright Wave Percussion Boards (124-046769 and 124-046769-001) or the Synthesis Percussion Assembly (124-000223-001 with 13 associated daughter boards, 124-000259) are available on the upper manual only. The Synthesis Percussion Assembly generates square-wave outputs for subsequent shaping into sine-waves by a filter network in a manner similar to other 380 IC systems in the instrument. However, in this case, keying outputs are supplied from an external source, the Bright Wave Percussion boards, which provide a percussion envelope as well. The keying signals enter mother board at J-114, J-115, and J-116, then go to proper daughter board, passing through an additional percussion time constant (R1, R11, C1, R6) before reaching the daughter board octave input terminals, (1 through 5). Signal outputs to sine filters are at J-113. Repeat and alternate repeat pulse enters mother board at J-108, from J-149-4 through -11 of the Synthesis Percussion Gates Board (124-000261), an assembly used for controlling negative going pulse wave-forms between the Repeat Oscillator and Detector board, (124-000260) and the Synthesis Percussion Mother Board, (124-000223-001) in repeat and alternate repeat modes. In normal keying mode, +25V is applied to the base terminals of Q9-Q18, placing them in a saturated state and shorting input to ground. When percussion tab is depressed, -14V is impressed on terminals J-148, 6, 7, 8, 9, 11, 12, 13, 14, and 15, placing Q9-Q18 in a non-conducting state, opening gates and shunting input signals through to appropriate output terminals. Phase A alone admits repeat signal only, at J-148-4. Phase A, plus phase B, adds alternate repeat signal at J-148-5, for twin mallet effect on Xylophone and Marimba voices. The Bright Wave Percussion system, consisting of the 124-046769 and 124-046769-001 boards supplies stairstep signals for all "bright" voices, (Pizzicato 1, 2, Piano Solo, Harpsichord, and Banjo) plus keying outputs and percussion time constants for the Synthesis Percussion assembly (124-000223-001). IC keyers (075-000426) combine octavely related square waves in the correct proportions to produce a stairstep configuration. Each 426 IC supplies outputs for all octaves and pitches for 2 notes on the upper manual. (For example: five pitches of F# and G notes on the upper manual). Dividers inside the IC, divide down the Clock (Top Octave) inputs, (J-135, J-136, J-137) to the frequencies required by the keyers. A negative DC voltage (-28V) is applied to the keyers to turn on all pitches of that note. The outputs of each pitch are combined by octave for group filtering, when necesssary. To minimize interaction between keyers feeding the same filter, the input impedance of the filter is made 100 ohms or less. Consequently, the output voltage at the filter terminals (J-133-2, 3, 4, 7, 8, 9) is very low when the filters are connected. To obtain a suitable envelope, a percussion time constant circuit is connected between key inputs and the IC keyers. The capacitor in series with the input (C1 on schematic 094-045062) passes an initial spike as the key switch is closed. As the switch remains closed, R2 to R5 drain off the charge on the keyer side of C1 toward the cut-off bias set as SUS-4. If key is released immediately, C2 discharges through the same resistors, giving a short key-up tail to the note. D3 prevents discharging through the input circuit. R6 works with C1 and C2, slowing down the attack time to minimize "key click". For repeat and alternate repeat modes, percussion keyers must be converted to straight-through keying. (See Repeat, Section 4-B). This is accomplished when -28V is applied to J-133-15, allowing R1 and D2 to discharge C1 quickly. To prevent cancellation effects, the 426 IC outputs are synchronized with the other Concorde keyer-generator systems. A "master" sync signal from J-109 on the Lower Manual Synthesis Mother Board, (124-000223), enters the clear inputs of the IC's (J-135, 7, 8; J-136, 7, 8; J-137, 8, 9) causing them to act as "slaves". Keyer cut-off control R22, located on the 124-046769 board, is used to adjust the point to which the keying voltage decays during the sustain portion of the percussion mode. Thus, all Percussion Keying outputs, with the exception of those from rhythm units, come from the Bright Wave keyers and when percussion system is activated, each note has its own percussion keyer. The decay-before-release function causes notes to die away even if keys are held down.

B. REPEAT

When repeat is used, however, keyers must convert from percussion to normal mode so that as long as keys are down, enough signal is present for the repeat keyer to turn on and off. This is achieved by the Repeat Oscillator and Detector assembly, (124-000260). When the Repeat tab is "on", no connection is made to terminal 8, therefore, Q14 and Q15 are off and terminal 13 is at about -28V. This voltage applied to convertible keyers puts them in normal mode. With the Repeat tab "off", Q14 and Q15 conduct, bringing terminal 13 near zero volts which places convertible keyers in percussion mode. Depressing the Piano tab applies -6V to terminal 10, putting the keyers in percussion mode, overriding the Repeat tab. The FF tab selects between -5V low volume and -10V high volume gating potentials. The Repeat Oscillator and Detector senses when any upper manual keys have been played and activates circuitry which produces repeat and alternate repeat percussion keying pulses. The legato pulse generator for the lower manual is also located on this assembly.

Activating the "B" preset key affects this assembly by applying -10V through R44 to the base of Q13 causing it to conduct, turning Q12 off and bringing Q11 nearer saturation, which gates a higher potential to drivers Q16 and Q19, thus providing greater signal amplitude at repeat (Pin 3) and alternate repeat (Pin 4) outputs.

Q1 and Q2 comprise the upper manual key-down detector. When no keys are played, Q1 and Q2 are biased off, terminal 15 is near -28V. If any keys are played, current applied through R1 turns on Q1 and Q2 and their collectors drop to -26.5V, firing monostable multivibrator Q3 and Q4. A negative going pulse from the collector of Q4 enters the "OR" gate at R7, R8 along with negative voltage from the collectors of Q1 and Q2 and is applied to the base of Q5, causing terminal 19 to go to -28V. The period of the monostable multivibrator is adjusted to keep terminal 19 negative during the entire time that manual keys might exhibit "bounce".

REPEAT OSCILLATOR AND KEYERS:

When no keys are being played, Q9 is conducting, keeping C5 discharged. Upon playing any keys, Q9 is biased off, and C5 starts charging through R14 and the repeat rate potentiometer. Q8 does not conduct until C5 charges to a specific voltage, then Q8 turns on and quickly discharges C5. The resulting current flow through R16 produces a pulse which is amplified by Q10 and used to trigger keying bistable multivibrator Q17 and Q18. The keying multivibrator remains in the state it is in when the last key is released. Subsequent playing of a key causes negative voltage at terminal 19 to be transmitted through D19 to the multivibrator, setting it to the state where Q17 is off with its collector at zero volts and Q18 is on with its collector at -14V. Should the multivibrator already be in this state, it will remain there. After the initial pulse via D10, each succeeding pulse from Q10 will change the state of the multivibrator.

Positive going voltage changes at the collector of Q17 are differentiated and applied to the base of Q16. The negative pulse output at the collector of Q16 charges the timing capacitor C17 through D15.

If the rest state of the multivibrator is such that the collector of Q11 is positive, no pulse is present to drive Q10 when the first key is played. To insure the availability of a drive pulse, a signal is coupled from the collector of Q3 through D17 and C20 to the base of Q16. (Q6 produces a positive pulse with the first key down). C15 starts to discharge rapidly through D14 and R33 toward a voltage level determined by voltage divider R32 and R33. As the voltage at C15 becomes more positive than the voltage set by R32 and R33, D14 cuts off and C15 continues to discharge at a much slower rate through R40. The initial rapid discharge gives uniform duration of notes at fast repeat rates and keeps notes from sounding too short at slow repeat rates.

Q22 and Q23 make up a Darlington amplifier with a high input impedance which provides a low output impedance to drive the Synthesis Percussion Gates (124-000261) circuitry in the repeat mode. The positive going output at the collector of Q18 is used in a similar manner along with Q19, Q20, and Q21 to drive the Synthesis Percussion Gates Circuitry for the alternate notes in the Xylophone and Marimba voices.

Q6 and Q7 make up a monostable multivibrator for use as lower manual legato detector. Q7 is normally conducting, holding Q6 off. When a lower manual key is played, the voltage across R55 triggers the circuit causing Q6 to generate a negative pulse at terminal 9. This action repeats for each additional key until 15 or 20 are played.

C. PIANO

The Concorde Piano voice is produced from a stairstep wave input on the Piano Filter P.W.B. (124-000207). It has three filter groups fed by a five octave input with the three lowest octaves tied together and applied to a single filter section. IC keyers develop a signal of 150-200 mv P-P at the 150 ohm input load resistors. Active low pass 2 pole filter sections are used, with an extra high pass filter stage in the two highest octaves providing a sharp low frequency cut-off slope to reduce keying thump to an acceptable level. The lowest octave uses input and output coupling capacitors to control low frequency cut-off. The three filter groups are mixed into summing amplifier Q2 and passed through another active low pass 2 pole filter section, where Q3 provides a low impedance output for Piano and Piano Solo inputs on the Bright Percussion Filter Board Assembly (124-000208).

Another function of the Piano Filter Board is, supplying an output for the low impedance filters on the Bright Percussion Filter P.W.B. (Pizzicato 1, 2, Banjo, Harpsichord), the five octave stairstep wave frequencies are resistively mixed into bright summing amp. Q10, (bypassing the piano filters) which provides a low impedance output at Pin 11. A resistor in series with the output supplies automatic robbing so that one voice can be loud enough without having several voices at an unreasonable level simultaneously.

NOTE: Earlier versions of the 124-000207 Board contained five filter groups for the inputs instead of three, but were similar to the current design in all other aspects.

D. MIXING

Banjo, Harpsichord and Pizzicato voices are produced on the BRIGHT PERCUSSION FILTER BOARD (124-000208) using stairstep waves from Pin 11 on Piano Filter board---(124-000207). Signals enter the board at J-106 and pass through three active filters; Pizzicato 1, 2, and Banjo, a passive filter is used for Harpsichord. The filter outputs are mixed with a Piano voice input from the 124-000207 board into the repeat gate composed of Q7, Q8, Q9, and Q10, a two stage differential amplifier that has the emitter current of its first stage (Q8-Q8) supplied by a sawtooth repeat signal from J-147 on the Repeat Oscillator and Detector board (124-000260) when repeat is on, or a DC level when repeat is off. There is a null adjustment (R28) to minimize repeat thump, requiring a matched pair of transistors (001-021260-001) in the first stage to achieve the best null. Tab action changes the D.C. level at the repeat gate providing Fortissimo as desired. When Piano Solo is used, repeat signal and control voltage are removed, turning off Bright Percussion.

2100 (CONCORDE) THEORY OF OPERATION-SHEET 2 OF 3

On-Off gating at Q2 and amplification at Q3 are provided for Piano Solo whose input at Pin 2 bypasses the repeat gate. Synthesis percussion signals enter this board at Pin 19 and are summed with repeated bright percussion and Piano Solo at output amplifier Q12. Gain controls are provided for these signals at R69 (Solo), R44 (Synthesis), and R17 (Bright). The required +21V comes from the Piano Filter board (124-000207) which has a decoupling filter for the supply.

NOTE: Earlier versions of the 124-000208 Bright Percussion board have matched 001-021270's in the repeat gate, (Q7 and Q8).

5) VOICING

The characteristic sound of the organ voice is obtained by mixing sine-wave signals produced in a variety of filter sets.

A. MAIN FILTER SYSTEM

Square-wave outputs from the upper and lower manual synthesis and percussion 380 mother boards go to separate sets of sine-wave filter boards, (three filter P.W.B.'s for each mother board, 124-000201, 202, and 204) where they are used to produce sine-wave tones. There are 14 filter groups in each set to match the 14 signal output terminals of a typical 380 assembly. Each group passes one 12 interval octave plus one note, with the exception of group #1, which is for frequencies #1 through #12 only. Pass bands of the filter groups overlap by necessity due to the combination of pitches on the 380 outputs. A total range of 8 octaves is available. (Frequencies #1 through #97).

On the first five groups, a 150 ohm resistor is used at the input to develop the square-wave output current from the 380 keyers into a signal of approximately 80 mv peak to peak for one note at tonebar position 8. On all remaining groups the keyer current is summed in a bus amplifier input of very low impedance (10 ohms). The output current at the collector of this stage is the same amplitude as is developed across the 150 ohm resistors on the first five groups. The bus amp is used to prevent IM distortion from interaction between the IC keyers. It is not needed on the lower frequency groups because the IM difference frequencies are mostly sub-audible.

Most of the filter groups are two stage, 8 pole, active band-pass filters. The first stage has a pronounced peak near the top of the pass band. The second stage starts the roll-off just above the low end of the pass band, a combination which provides a reasonably flat pass band with a sharp attenuation curve. Input and output coupling capacitors are used to reduce keying thumps by providing low frequency roll-off. Filter group #1 has one RC section deleted as the sine-wave purity requirements are not as severe at low frequencies.

Filter group #14 has only one stage since the harmonics are at the upper limit of hearing. All signals from the 124-000201 and 124-000204 boards go to the 124-000202 board where Q13, a phase inverter, sums the outputs of groups one through five which do not have bus amplifiers. The remaining signals along with those from the phase inverter feed into Q14, and output amp on the 124-000202 board. Mixing resistors in the output of each filter group are selected to provide the necessary tapering. (Higher output at lower frequencies). TVI suppression capacitors are provided and isolating resistors are used to prevent failure of the output amp or the phase inverter.

NOTE: Earlier versions of these boards do not have TVI suppression capacitors or isolation resistors.

B. PEDAL TONES

Pedal output signals (Square-Wave) from J111 and J112 on the Lower Manual Synthesis mother board, (124-000 223) enter the 16' and 8' active low pass filter circuits at J104, pins 4 and 7 of the Pedal Filter board, (124-000206) where sine-wave pedal tones are produced. 8' string Bass gating and a pedal down detector are also provided. The String Bass gate is a two stage differential amplifier, (Q5-Q6 and Q7-Q8) which operates in a touch response percussion mode, but does not decay to inaudibility. Touch response keying information for the String Bass circuit and follow-the-player rhythmn is provided by the pedal down detector, which connects to the pedal keying bus. R47 and R48 prevent Q10 in pedal down detector from failing when pedal keying bus is shorted to ground. Pedal tones go to associated terminal strip and to either J141, pins 1 and 9 on the Auto-Accompaniment board (124-000360) or to pedal tonebars through external 12K resistors, then back to Q9 on Pedal Filter board for amplification and mixing with String Bass.

CAUTION NOTE: Early models of the 124-000206 board do not have protective resistors, therefore pedal keying bus must not be shorted to ground.

C. SIGNAL DISTRIBUTION

The sine wave filter and pedal filter outputs proceed to mixer #2 (124-000374), which is used to provide animation cancel circuitry, swell pedal contouring for main and tremolo channels, mixing of upper and lower manual signals into After Vibrato or Acoustic Tremolo, and mixing of After Vibrato output, percussion, rhythm low frequencies, and pedal signals into the main channel.

A brilliance control is included for the upper manual. When brilliance control is on, a ground is removed from the circuit allowing upper manual response to be flat. Turning off the brilliance control connects circuit to ground and response rolls off 3 DB/octave from 2000 HZ. The control has a built-in 2 DB loss, which enables the lower manual brilliance control on the Auto-Accompaniment board (124-000360) to be effective.

The animation cancel circuitry is an electronic single pole, double throw switch with "pop" suppression, activated by -28V applied through the expression pedal left side switch. Closing the switch removes all signals in the tremolo channel and routes them to the main channel. In parallel with the "Sustain to Foot Switch" tab, an electronic switch opens the upper manual 380 time constant circuit, converting the keyers to long sustain mode. Another switch grounds the After Vibrato On/Off control line, removing vibrato.

NOTE: Previous Concorde models came with a 124-000211 Mixer #2 Board a device similar to the current design, but without "pop" suppression and incorporating a pedal control pot which is now on the Auto-Accompaniment (124-000360) assembly.

After this stage, the signals are routed through the expression pedal control to mixer #3 board (124-000212) which provides cassette mixing, phono preamplification, acoustic tremolo cross-over filtering, expression pedal contouring, (For rhythm white noise voices.) a chorus input, and final mixing before main and Tremolo power amplifiers. Single stage mixer preamps, (Q3 and Q7) are used for phono and cassette inputs at J-145-19 and 13. Q1 supplies contouring for Rhythm III white noise voices. (input at J-145-18) Q4 and Q5 are low and high pass filters for the tremolo channel whose input is at J-145-4. Because final tremolo signals are acoustic and cannot be recorded directly, animation of recorded signals is accomplished by routing tremolo channel through the reverb after vibrato (124-000213) via J-145-5, then back to mixer #3 via J-145-13 where it is coupled by R25, R26, and C16 to the base of amplifier Q3 and proceeds to cassette input from J-145-12. If desired, reverb must be added to recorder playback signal. R22 controls output gain of summing amplifier Q2, final mixer for the main channel, at J-145-21. The tremolo channel output is at J-145-1, and the gain of the summing amp for this channel (Q6) is regulated by R51. C34 and R55 make up a +25V decoupling filter which reduces turn-on thump. Input impedance of the phono preamp is 50 K ohms and an input of 250 mv drives the main power amp to an output of 35 watts R. M. S.

NOTE: Decoupling filter R55-C34 is not used on earlier versions of this assembly.

6) RHYTHM

The Rhythm III assembly is virtually independent of the instrument except for power supply and auto-accompaniment functions. It has its own tone generators, voicing board, and switching facilities. The Timing Generator assembly (124-000214) performs the digital functions of the system.

A. PATTERN & TEMPO

Timing rates are geared to a relaxation oscillator controlled by a programmable unijunction transistor (PUT). The rate is controlled by varying the charging current for C1 through the control panel pot. Oscillator output drives a buffer transistor which, in turn, drives a five stage counter made up of 3 dual J-K, DTL flip-flops. Half of IC-3 provides pulses at a beat rate to the lamp (one-shot only) when stages 2 through 5 of the counter are reset by Q3 and Q6. The five stage counter normally accepts 32 pulses before restarting. When Waltz or Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will cause the counter to restart after reaching 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 driving the tempo lamp at a measure rate. A set, re-set bistable made up of Q8 and Q9 with resistors R64 through R71, is used for the Touch-Start circuit. Q8 provides voice gating signals for the voicing board (124-000180) and for generator gates controlled by Q7 and Q10. A positive pulse applied to the reset input (J1-2) causes Q8 to provide a ground signal that turns off voice gating circuits, (J1-3) and is inverted by Q7. A positive signal is supplied by Q7 to Q3 and Q6, who, in turn, reset stage 2 through 6 of the counter and the beat rate divider. (Pin 9 of IC3). A positive pulse to any of the three "start" inputs, (J1-1, J1-11, J1-12) causes the bistable to change state, allowing the voice gates to open, removes the reset signal from stages 2 through 6 of the counter, turns off the beat rate divider, and provides a pulse to reset stage 1 through C4. The counter outputs are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences. The matrix has 21 output tracks which are fed to the Rhythm Selector Board (124-000196).

B. RHYTHM VOICING

On the Voicing board, (124-000180) four of the eight rhythm voices are generated by RC oscillators turned on by pulse amplifiers which provides bias current for the oscillators. All oscillator outputs are mixed and fed into a low frequency pre-amp whose output is at Pin 1 of J4. The remaining voices come from a reverse biased transistor, white noise generator, (including the high frequency part of the snare drum voices), which produces random frequencies that are shaped and filtered to form appropriate voices. These voices are combined and fed into a high frequency pre-amplifier whose output is J4 Pin 2. The two pre-amp outputs connect to separate sections of a dual volume control from which they enter the main audio channel. Follow-the-player voices are another feature of the unit. Two pulse inverters act on signals from the lower manual legato mode and pedal touch mode trigger circuits.

The lower manual inverter output (J4-14) can be switched to the Brush (J4-12) or Snare Drum (J4-7) input with front panel tabs. The pedal inverter output (J4-13) is switchable to Bass Drum (J4-20) or Cymbal (J4-4) input by actuating the proper tab.

C. AUTO-ACCOMPANIMENT

The rhythm unit also supplies trigger pulses to the Auto-accompaniment board (124-000360) which provides gating for lower manual and pedal voices, when automatic accompaniment and chording is desired. The lower manual gate has a fixed time constant provided by a two stage differential amplifier with the emitter current of the first stage supplied by pulses from the rhythm unit, and turns off when supplied with a DC level. A brilliance control is provided at the output which grounds J-142-9 to roll off response 3 DB at 2000 HZ when off. In the "on" position, ground is removed, making high frequencies apparent. Gain is unity with no phase inversion and a null adjustment is provided to reduce thump. Pedal gates are single transistor keyers and pedal down audio gating is used to prevent thump when no signal is present. A pedal snubber circuit is provided to allow channelling of pedal and lower manual signals into the tremolo unit. Pedal gain is controlled by potentiometer R31.

NOTE: On early models of the Concorde, the Auto-accompaniment functions are carried out on the Mixer #1 board (124-000210), which is similar to the current asembly but has an additional differential gate and null adjustment (for the pedals) and uses diodes to kill sustain on lower manual and pedals. Pedal snubber circuit and pedal gain pot are not provided on this board.

7. SPECIAL EFFECTS

The following devices are employed to expand the musical performance of Concorde Series organs.

A. REVERB

Reverberation is an acoustic effect that naturally occurs in a large enclosed space when repeated reflections of a sound are only slightly out of phase with its source, permitting the signals to partially blend and preventing the reflection from being perceived as a separate sound or echo. Music is usually enhanced in this manner as a result of being performed in a theater or recital hall.

The Concorde reverb system simulates this effect electronically. Part of the main channel output is diverted to an amplifier then through a transducer where it is converted to mechanical vibrations, subjected to a precise delay characteristic by traversing a long spring, recovered through reverse transduction, amplified, and sent to the final mixer, arriving slightly behind the main signals that are routed to this point directly.

From the expression pedal (J144-6) the signal enters the reverb amp (124-000166) through R1 (J1-6), and is coupled through C2 to the base of Q1. Bias for Q1 is obtained through R5. From the collector of Q1, the signal is directly coupled to the base of emitter-follower Q2, which is biased through R7. From the emitter of Q2, the signal is developed across R8 and coupled by C3 and R9 to the base of Q3. Bias for Q3 is supplied through R11. From Q3's collector, the signal is coupled in half-wave position to push-pull amplifier section Q4 and Q5. The negative portion of the signal, which is prevented from reaching Q5 by forward biasing D1 and D2, is direct-coupled to the base of Q4. (NPN). The amplitude of the positive portion of the signal is sufficient to reverse bias D1 and D2, and this portion of the signal is then passed to the base of Q5 (NPN). The outputs of Q4 and Q5 are combined at the junction of R17 and R18 and coupled through C6 and J2-1 to drive the reverb unit. Negative degenerative feed back is taken from R16 and connected through R15 to the emitter of Q1. Due to the insertion loss of the reverb transducers and springs, output of the unit must be amplified. Signals enter the recovery amplifier at J2-5 and are coupled through R19, R20, and C9 to the base of Q7. Bias and feedback for Q7 are supplied through R21. The output at collector of Q7 is direct-coupled to the base of Q8. The output at the emitter of Q8 is coupled to J1-1 through C11 and R26 before passing on to the final mixer. R26 is part of a reverb level control.

B. VIBRATO

Varying the pitch of a single or complex tone at a uniform rate is an ancient practice. The first music heard was the human voice, which has a built-in vibrato. All subsequent efforts to produce pleasing sounds were more or less aimed at equalling the appealing qualities of the "original musical instrument". Consequently, some form of vibrato was employed.

Because the Concorde is equipped with a crystal-controlled, "non-vibratoable" master oscillator, and is a synthesis type organ, the vibrato circuits are introduced after tone synthesis is completed, before final mixing. Two After Vibrato printed wiring boards are used, (124-000213) one each for the main and reverb channels. The desired vibrato rate is 4.8 to 6.8 HZ.

Since both After Vibrato circuits are similar, only the operation of the main channel system will be described. These are the sub-circuits included in each After Vibrato system:

1. Vibrato rate oscillator with on, off, rate, and amplitude controls.
2. Adjustable regulated bias supply and regulated reference supply voltages.
3. Four cascaded, variable phase shift circuits.
4. Output amplifier.
5. Output time delay.

From Q1 of the vibrato mixer (on Mixer #2 Board 124-000374), signals enter a potentiometer voltage divider (J151) on the 124-000213 board. This provides a maximum level at the emitter of the first phase splitter of .035V R.M.S.

The Darlington phase splitter develops signals 180° out of phase at the collector and emitter of Q2. The signals are combined in the network of the collector capacitor, C3 and the FET, a section of IC1 which is used as a variable resistor. The source-to-drain resistance of the FET is controlled by a DC voltage appearing between the source and gate terminals. When the gate is slightly negative to the source, the drain-to-source resistance is low (100-600 ohms). As the gate is made more negative to the source, the drain-to-source resistance rapidly increases to many megohms. This high resistance is limited to 24K ohms by R6 and R7 in series across source and drain of the FET. By applying DC bias to the gate and superimposing a vibrato rate sine-wave on the bias, the source-to-drain path appears as a pure resistance, varying at a predetermined rate from 100 to 24K ohms, in a sine-wave configuration. Feedback at the FET gate is supplied from the junction of R6 and R7 through C4 to cancel phase distortion of the FET. The signal at the junction of C3 and the drain of the FET varies in phase due to the reactance of the capacitor in conjunction with the varying resistance of the FET.

How phase shift occurs: Assuming the two extremes of FET resistance to be zero ohms and infinity, at the zero point the collector signal is attenuated by the reactance of capacitor C3, so the signal appearing at the junction of C3 and the FET has the phase of the emitter signal. When the FET goes to open circuit or infinite resistance, the C3-FET junction is connected only to the collector signal, phased 180° away from the emitter signal. Since reactance is a function of frequency, a frequency occurs where capacitor C3 reactance equals FET resistance. At this point, the phase appearing at the C3-FET junction is 90° away from both collector and emitter. As the FET resistance varies smoothly between its limits, the phase of signals appearing at the junction varies smoothly between the limits determined by capacitor reactance and signal frequency. Since an instantaneous change in phase is equivalent to a change in frequency, a vibrato effect is obtained when phase is changed at vibrato rate in a sine-wave manner. A single stage does not provide sufficient phase shift for the required vibrato effect, so four stages have been cascaded. The fourth stage is amplified to provide standard level (1V) and impedance. The single transistor joining the base of the final output transistor to ground is a delay switch to hold output cutoff until circuit voltages have stabilized after power is applied.

2100 (CONCORDE) THEORY OF OPERATION-SHEET 3 OF 3

C. ARPEGGIATOR

An electronic system for producing an arpeggio, glissando, or whole tone scale as desired, by stroking a miniature keyboard under a mylar strip located between the manuals. This device is connected to the Arpeggiator Board (124-047850). Next to the strip is a switch that selects between MANUAL and AUTOMATIC modes. In the MANUAL mode, ground is disconnected from Q1 and Q2, through R2 and R3. The keys depressed on the lower manual determine which notes registered on the upper manual will be heard, including those in octave relation thereto. If no lower manual keys are activated, the Arpeggiator strip is dead. Twelve circuits are used, one for each note of the scale. Diodes D24 through D32 activate the "C" buss whenever a "C" note is keyed on the lower manual, while providing isolation between the lower manual keyers.

Similarly, the "C#", "D", "D#", etc., busses will activate when these notes are played. Keying a buss will apply voltage on all octaves of that note on the Arpeggiator switches. Now if the Arpeggiator is stroked, all octaves of the notes held on the lower manual will sound in succession as if they had been played on the upper manual, due to the connection of the Arpeggiator switches to the upper manual keyers.

Operating in AUTOMATIC mode, Q1 and Q2 are normally turned on by grounding their bases through R2 and R3, supplying -18V to all keying busses from the emitters through the collectors and diodes D1 through D6 and D15 through D20. (when no keys are depressed on the lower manual) This activates all busses at slightly less than full keying voltage. When the Arpeggiator strip is stroked, all notes play in succession (GLISSANDO). If notes in the same whole tone scale are depressed, -28V will be applied to the base of the associated transistor, turning it off and removing the -18V from the busses for the other whole tone scale. Only the proper whole tone scale, in tune with notes depressed, will play. If a chord is keyed on the lower manual that has notes in both whole tone scales, busses are activated with -28V on left and right sides, reverse biasing both transistors so only the busses for the notes depressed on the lower manual are activated. Consequently, only corresponding notes on the Arpeggiator become playable. Therefore, when the miniature keyboard is stroked, a glissando occurs if no lower manual keys are depressed, and an arpeggio is heard if one or more keys are held, but always in harmony with those keys. Signals from the Arpeggiator Board (124-047850) enter the Lower Manual Synthesis Board (124-000223) at J-117.

D. TREMOLO

By applying a portion of the main channel signals to a separate power output circuit, and driving a mechanically rotating speaker with it, the Tremolo system adds varying pitch and amplitude to the total organ sound. This signal comes from the main mixer, (Mixer #2 Board, 124-000374) via the expression pedal at J143-7, enters the final mixer (Mixer #3 Board, 124-000212) at terminal 4, goes to Q5, through a high pass filter, then is applied to Q6 and associated phase inverter and thereafter, to the Tremolo power amplifier.

8. AMPLIFIER AND POWER SUPPLY

A. AUDIO OUTPUT

Two 35 watt power amplifier building block modules, (124-000169), are incorporated into the Concorde power supply assembly. (126-000108-001 through 003). One module is for the main channel output and the other provides Tremolo power output. The circuits are identical and function like this: The input stage uses a differential amplifier, keeping the output at DC ground by compensating the bias of the output transistors. Eliminating bias problems makes quasi-complimentary output practical. Q1 and Q2 are biased equally to ground with R3 and R5. Because the load is connected to the base of Q2 through R5, the load is at ground potential. The DC feedback path from the load to Q2 is a convenient way to apply AC feedback which is controlled by R8 and R5 whose ratio determines overall gain. High open loop gain, permitting a large amount of negative feedback is due to Q3 operating with its emitter at AC ground (Class A). This transistor must stand the total voltage across the amplifier. D1, D2 and D3 are part of the load seen by Q3 and bias the output transistors. To bias Q6 and Q7 on the voltage drops across D1, D2 and D3 must equal the voltage drops across the emitters of Q4, Q5, and Q7, plus the drops across D8, R16, and R17. The current through the three series diodes is determined by R9 and R10, and this current determines the voltage drop across the diodes. To prevent crossover distortion, a Q6, Q7 quiescent current of around 40 ma. is necessary. Q5 and Q7 are NPN Darlington connected while Q4 and Q6 act like a PNP Darlington connection. R15 and D8 cause the overall transconductance of Q4 and Q6 to equal or nearly equal Q5 and Q7, improving output linearity. A bootstrap capacitor (C7) is connected between R9 and R10, enabling Q6 to be driven into saturation. Without the positive feedback path through Q7, drive to Q6 is insufficient for symmetrical output, an RC pad across the load (R18, C10) provides high frequency stabilization. Short circuit protection occurs during the positive cycle when series connected diodes D1 through D6 in parallel with Q4 and Q5 emitters and R17, shunt the drive to Q7 and clamp its collector current at a level just above the normal peak load current. The collector current of Q6 is clamped during the negative cycle just like Q7 with diodes D5 and D3.

B. POWER SUPPLY

A lighting transformer, tremolo relay, noise suppressing circuitry for tremolo, and four (4) fused, regulated and short-circuit protected power supply circuits (+25V, -14V, -28V, -8V) are the other items located on assembly 126-000108-001 through 003. The supply circuits used are quite conventional such as diode bridges with the usual filters. Protection and regulating circuits are worthy of mention however, and an example is herewith described: On the power supply regulator P.W.B. (124-000209), Zeners D6, D8, D16 and D17 supply reference voltage, potentiometers R7, R17, R27, and R37 are voltage adjustment controls for setting the base voltage of power transistors Q1, Q11, Q21, and Q31 thus setting output (emitter) voltage.

When the ouput load increases, the base voltage drops on regulating transistors, Q3, Q13, Q23, and Q33 allowing their collector voltage to become more negative bringing the bases of the power transistors closer to saturation and restoring output (emitter) voltage. If a short or similar condition is present, emitters of protection transistors Q2, Q12, Q22 and Q32 are grounded or brought near ground which in turn grounds the base terminals of the power transistors, turning off supply. Base resistors and diodes set the point at which protection transistors turn off.

SECTION III
DIAGRAMS AND TEXT

3–1. GENERAL.– This section contains schematic diagrams and text to illustrate and provide information necessary to proper organ servicing.

LIST OF ILLUSTRATIONS
2100 SERIES

LIST OF ILLUSTRATIONS
2100 SERIES

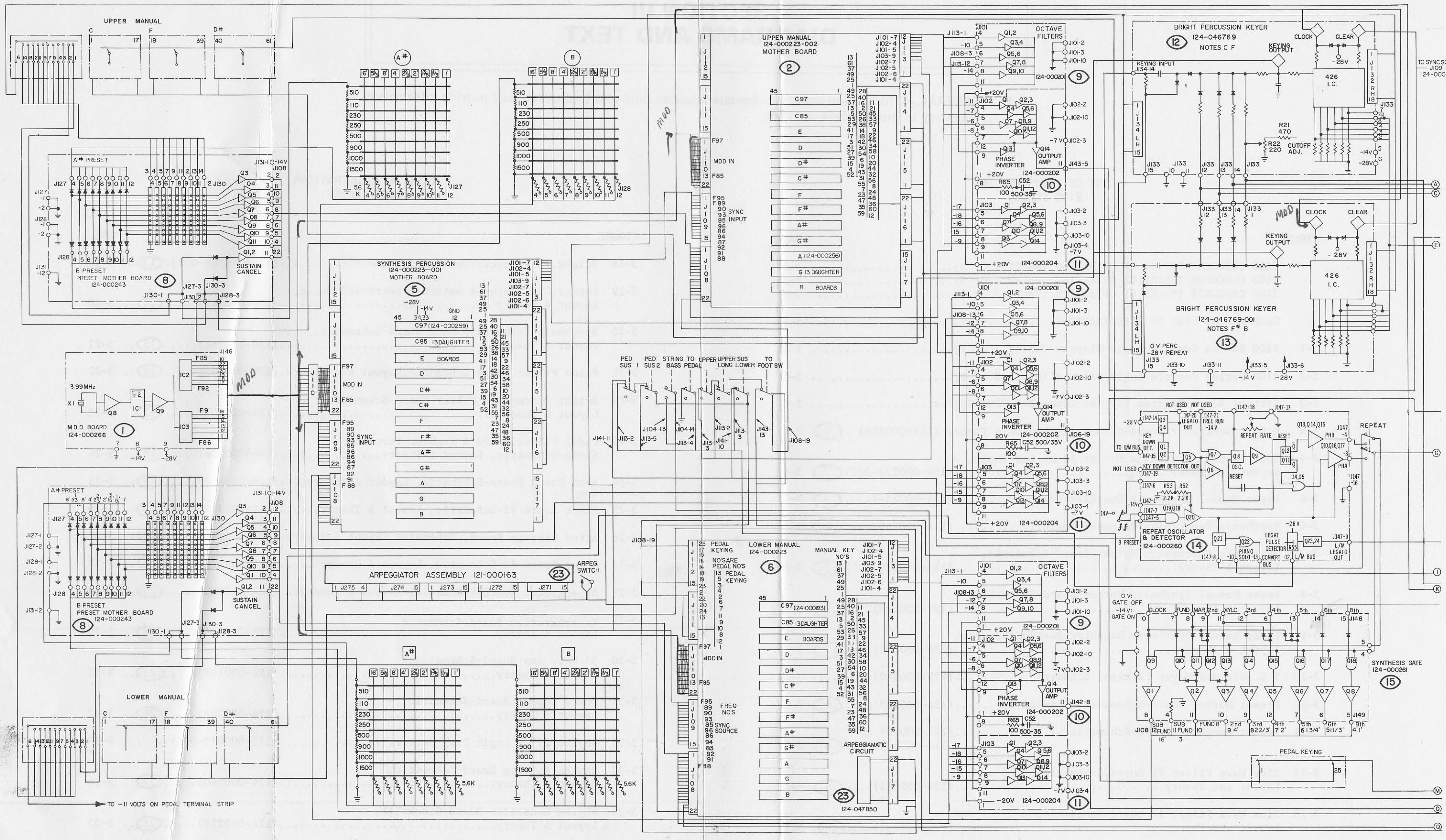
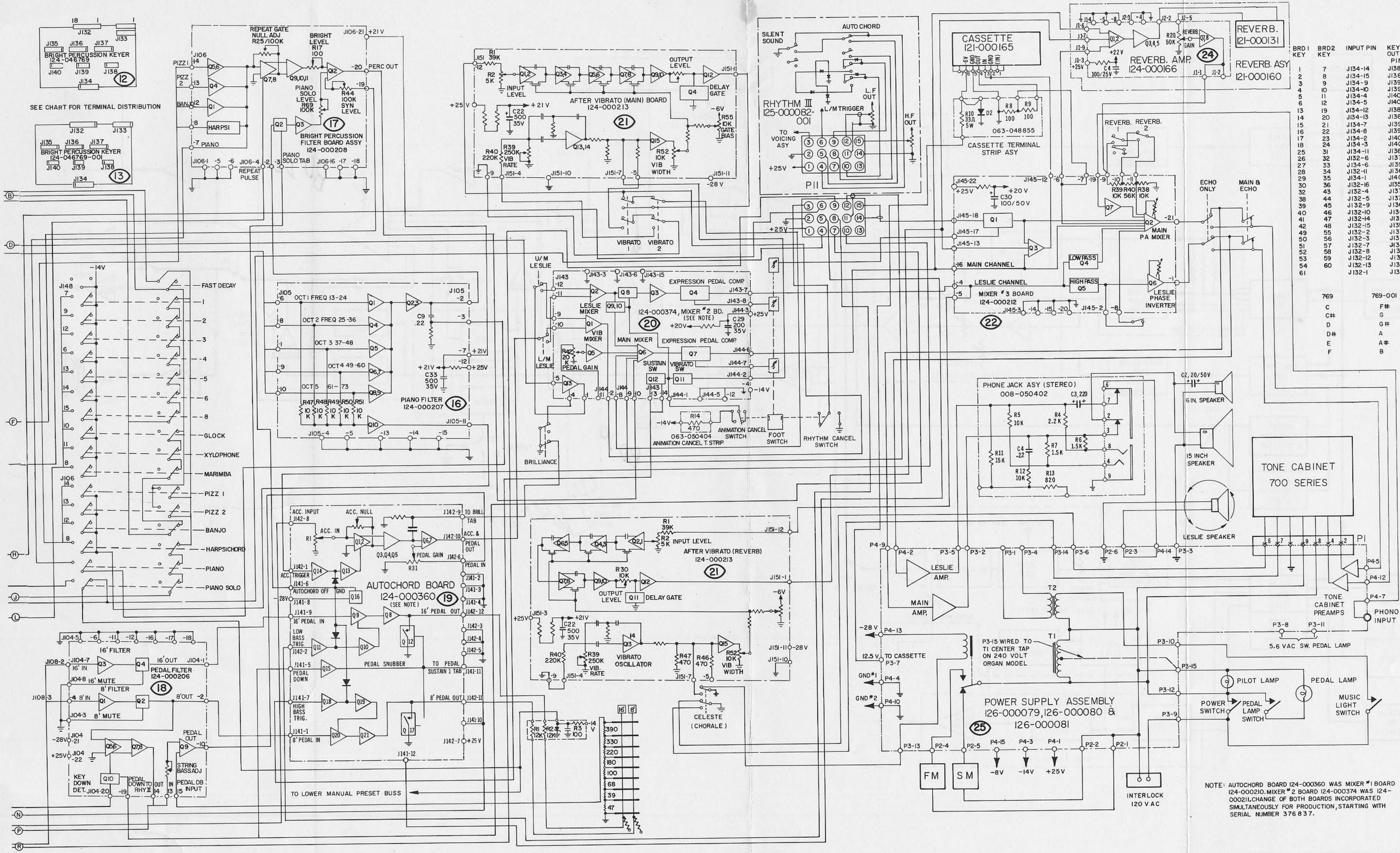


FIGURE 3-1
2100 SERIES CONSOLE
LOGIC DIAGRAM
(SHEET 1 OF 2)

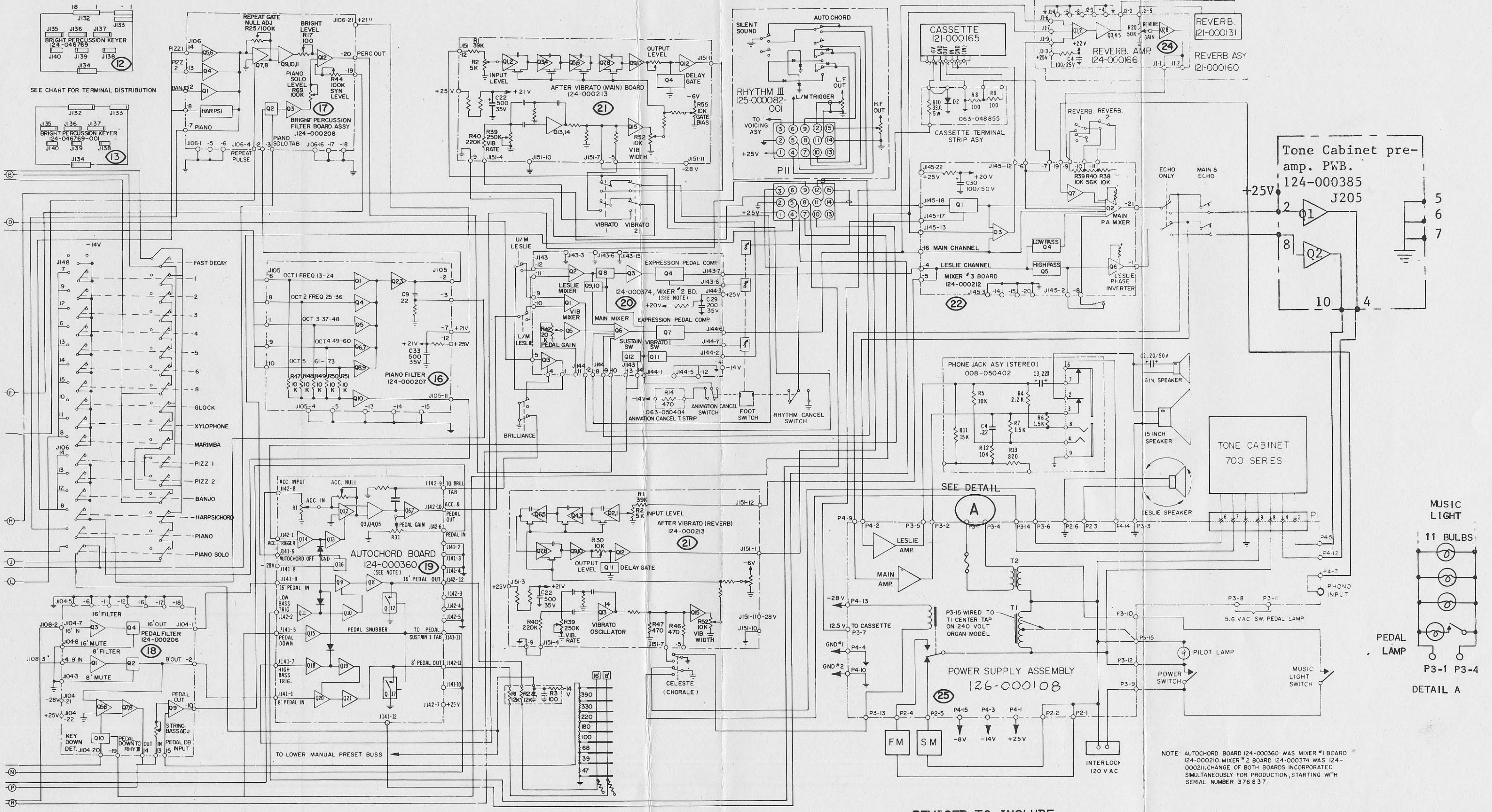


BRD 1 KEY	BRD2 KEY	INPUT PIN	KEYING OUTPUT PIN	SIG OUTPUT PIN	BRD 1 FREQ	BRD 2 FREQ
1	7	J134-14	J138-4	J133-2	13	19
2	8	J134-15	J138-5	J133-2	14	20
3	9	J134-9	J139-4	J133-2	15	21
4	10	J134-10	J139-5	J133-2	16	22
5	11	J134-4	J140-4	J133-2	17	23
6	12	J134-5	J140-5	J133-2	18	24
13	19	J134-12	J138-2	J133-3	25	31
14	20	J134-13	J138-3	J133-3	26	32
15	21	J134-7	J139-2	J133-3	27	33
16	22	J134-8	J139-3	J133-3	28	34
17	23	J134-2	J140-2	J133-3	29	35
18	24	J134-3	J140-3	J133-3	30	36
25	31	J134-11	J138-1	J133-4	37	43
26	32	J132-6	J137-6	J133-4	38	44
27	33	J134-6	J139-1	J133-4	39	45
28	34	J132-11	J136-5	J133-4	40	46
29	35	J134-1	J140-1	J133-4	41	47
30	36	J132-16	J135-5	J134-4	42	48
32	43	J132-4	J137-4	J133-8	44	55
38	44	J132-5	J137-5	J133-8	50	56
39	45	J132-9	J136-3	J133-8	51	57
40	46	J132-10	J136-4	J133-8	52	58
41	47	J132-14	J135-3	J133-8	53	59
42	48	J132-15	J135-4	J133-8	54	60
49	55	J132-2	J137-2	J133-9	61	67
50	56	J132-3	J137-3	J133-9	62	68
51	57	J132-7	J136-1	J133-9	63	69
52	58	J132-8	J136-2	J133-9	64	70
53	59	J132-12	J135-1	J133-9	65	71
54	60	J132-13	J135-2	J133-9	66	72
61		J132-1	J137-1	J133-7	73	

769	769-001	CLOCK	CLEAR
C	F#	J137-7	J137-8
C#	G	J137-10	J137-9
D	G#	J136-6	J136-7
D#	A	J136-9	J136-8
E	A#	J135-6	J135-7
F	B	J135-9	J135-8

NOTE: AUTOCHORD BOARD 124-000360 WAS MIXER #1 BOARD 124-000210. MIXER #2 BOARD 124-000374 WAS 124-000211. CHANGE OF BOTH BOARDS INCORPORATED SIMULTANEOUSLY FOR PRODUCTION, STARTING WITH SERIAL NUMBER 376837.

FIGURE 3-2
2100 SERIES CONSOLE
LOGIC DIAGRAM
(SHEET 2 OF 2)



NOTE: AUTOCHORD BOARD 124-000360 WAS MIXER #1 BOARD 124-000210. MIXER #2 BOARD 124-000374 WAS 124-000211. CHANGE OF BOTH BOARDS INCORPORATED SIMULTANEOUSLY FOR PRODUCTION, STARTING WITH SERIAL NUMBER 376837.

REVISED TO INCLUDE
126-000108 POWER SUPPLY
AND 124-000385 TONE CAB-
INET PREAMP BOARD IN
JANUARY 1976

FIGURE 3-2A
2100 SERIES CONSOLE
LOGIC DIAGRAM
(SHEET 2 OF 2)

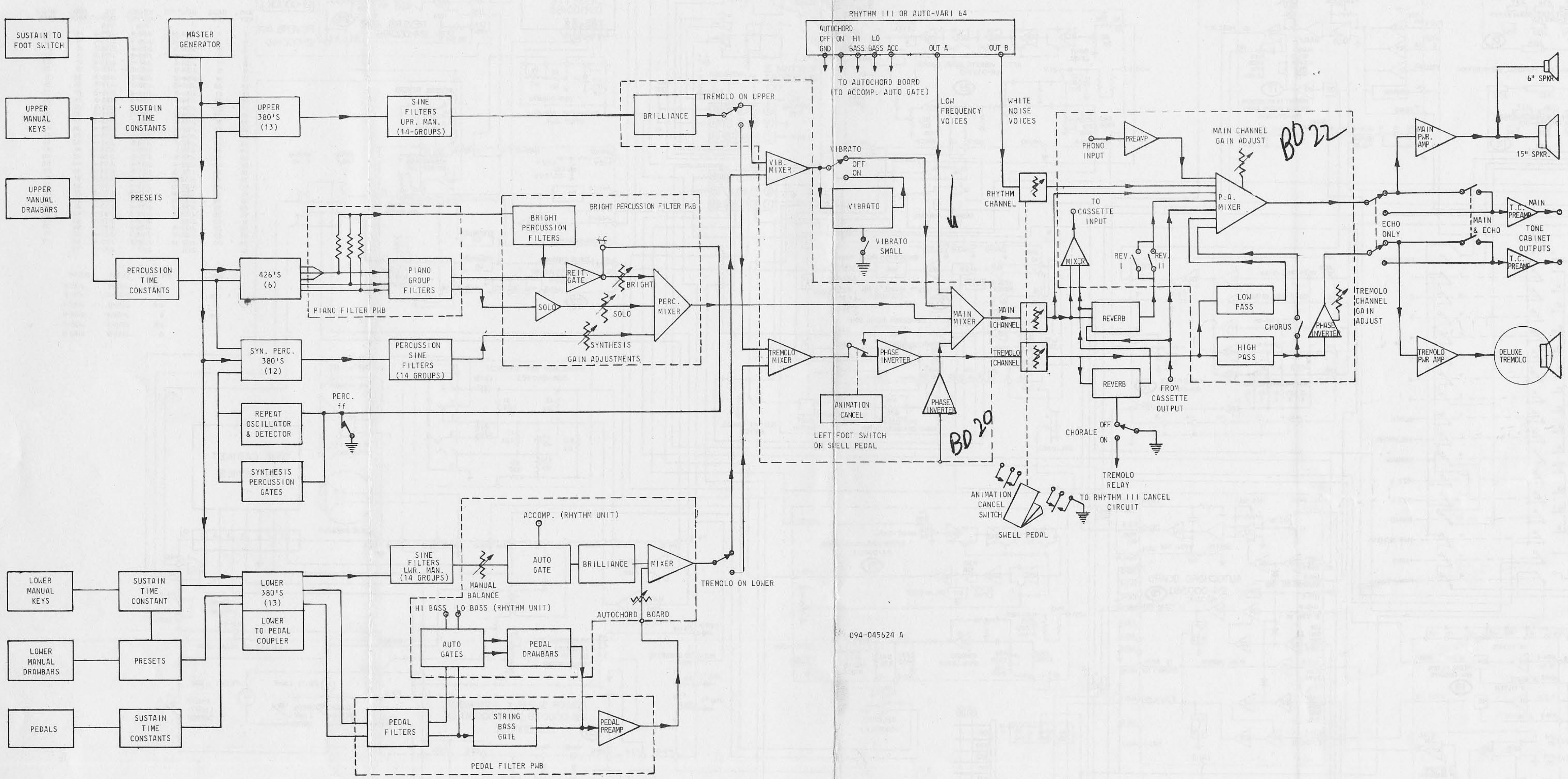
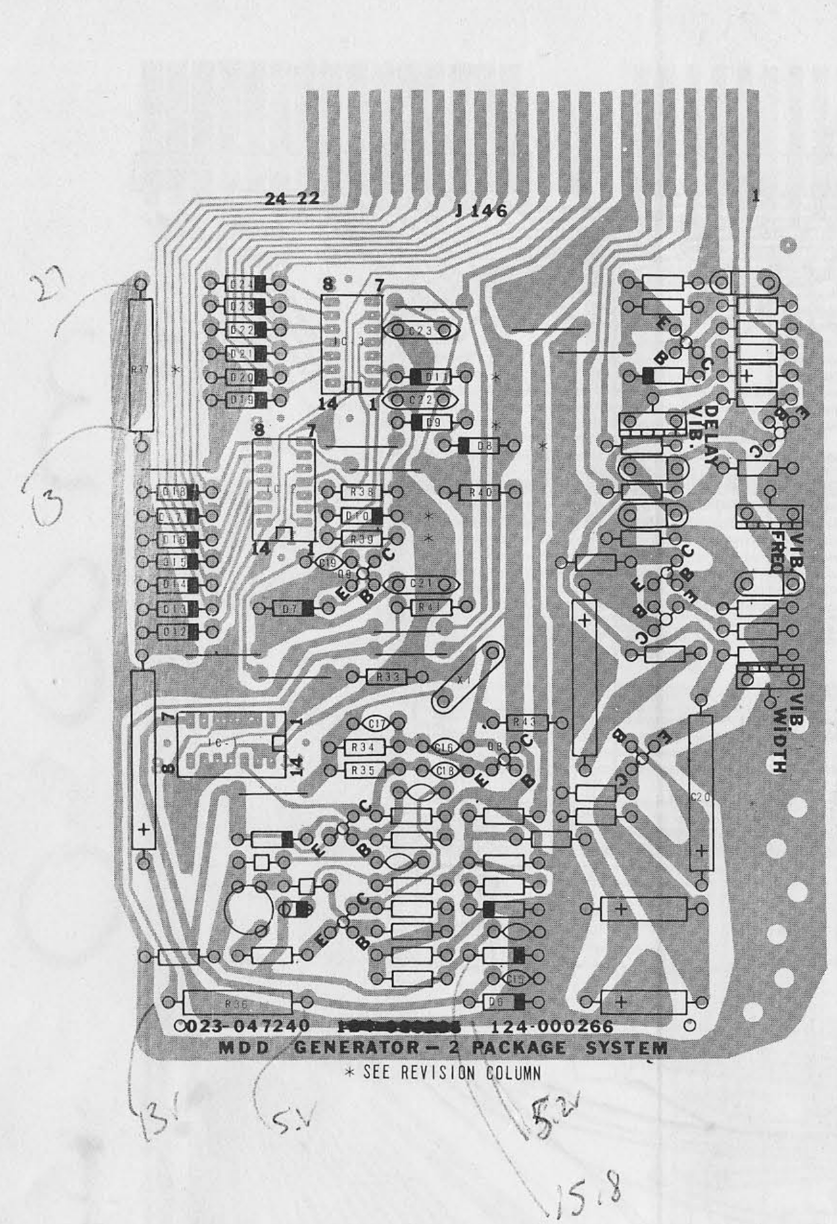


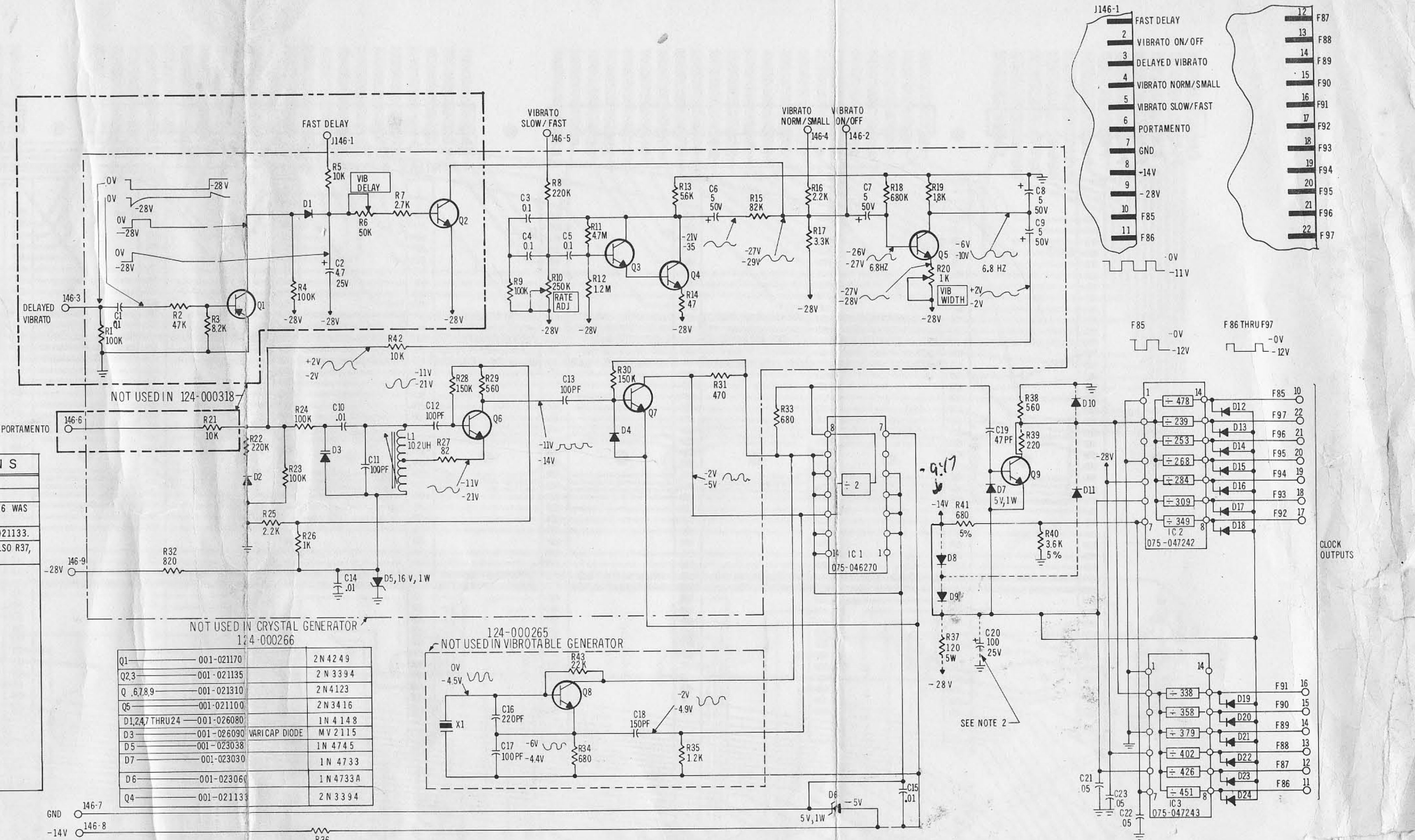
FIGURE 3-3
2100 SERIES SYSTEMS
BLOCK DIAGRAM



MDD GENERATOR — 2 PACKAGE SYSTEM

* SEE REVISION COLUMN

REVISIONS	
A	R41 WAS 1000 Ω, 5 %.
B	C6 & C7 WERE 25 V
C	C6 & C7 WERE 50/50 V. D6 WAS 001-223030.
D	Q6, Q7 & Q9 WERE 001-021133.
E	DELETED D8 THRU D11, ALSO R37, R39 AND C20.



NOT USED IN CRYSTAL GENERATOR
124-000266

Q1	001-021170		2N4249
Q2,3	001-021135		2N3394
Q ,6,7,8,9	001-021310		2N4123
Q5	001-021100		2N3416
D1,2,4,7 THRU 24	001-026080		1N4148
D3	001-026090	VARICAP DIODE	MV2115
D5	001-023038		1N4745
D7	001-023030		1N 4733
D6	001-02306(		1N4733A
Q4	001-02113:		2N3394

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS & 1/2 WATT, ±10%;
   ALL CAPACITORS ARE IN MICROFARADS.
2. COMPONENTS WITH CONNECTIONS IN DOTTED LINES WERE USED IN EARLIER MODELS, REF. REV. ISSUE "E".

124-000318, 124-000265, 124-000266

094-047241-E

MDD GENERATOR-TWO PACKAGE SYSTEM
VIBRATOABLE

Drawing 094-047241 is the schematic diagram for assembly 124-000265 (MDD with vibratoable LC oscillator) and for assembly 124-000266 (MDD with crystal oscillator). As indicated on the drawing, there are two "boxed-in" areas; one to be used for 124-000265 and the other for 124-000266; parts not in the boxed areas are common to both assemblies. In addition, a third assembly, 124-000318, is shown.

LC Oscillator With Vibrato

Assembly 124-000265 includes a vibrato oscillator, delayed vibrato circuitry, portamento capability (Auto-Glide), and a high frequency LC oscillator used to drive the MDD generator.

The vibrato oscillator is a phase shift type, comprised of C3,C4,C5,R9,R10,R11,R12,R13,R14, Q3 and Q4. Pot R10 is used to adjust the oscillator's frequency (6.8 HZ. nominal for fast vibrato); and R8 is externally connected to -28 volts for fast vibrato (disconnected for slow vibrato). The vibrato signal is coupled through C6, R15, and C7 to the base of transistor Q5, where it is amplified (its width being controlled by R20).

Vibrato may be turned off by connecting J146-2 to -28 volts, and may be reduced for "Vibrato Small" by connecting R16 through Pin J146-4 to -28 volts. To achieve a better sine wave the vibrato signal is filtered by C8 and is then coupled to the LC oscillator circuitry by C9 and R42. Delayed vibrato is accomplished by transistors Q1 and Q2. A -28 volt DC signal is applied to C1, which turns on Q1 for about 20 milliseconds; this charges C2 through D1 to a ground potential, turning on Q2 for approximately one second (until C2 discharges). When Q2 is turned on, the collector "shorts" the vibrato signal to -28 volts, thus the delayed vibrato time is approximately one second. Adjustment of R6 decreases or increases the time of the delayed vibrato. If the delayed vibrato signal is applied to C1 while J146-1 is connected to -28 volts, the vibrato delay time is decreased by 90 per cent.

The LC oscillator is comprised of L1,D3,C10,C11, C12,R27,R28,R29, and Q6, and is a Hartley type. D3, a varicap diode, is used to vary the oscillator's frequency for vibrato and portamento effects; as the voltage at the junction of R24, C10, and D3 becomes more negative, the capacitance of the varicap diode increases, and the oscillator frequency decreases. Since the cathode of the varicap is normally (with no vibrato) at ground potential and the anode is held at -16 volts by D5 and R32, the capacitance of the varicap remains constant (about 57 picofarads), and stability of the oscillator is maintained. Capacitor C10 is not part of the tank capacitance, but is used to isolate the DC bias on the varicap from the tank circuit. L1, in parallel with C11 and the varicap diode oscillate at 3.99872 M HZ. R28 and R29 are connected to -11 volts (generated by voltage divider R25 and R26) to supply an oscillator output swing of three volts.

A 6 per cent decrease in the oscillator frequency (Portamento, or "Auto-Glide") is caused by applying -8 volts to R21 at J146-6.

The oscillator signal is coupled through C13 to buffer amplifier Q7 which drives IC1.

A variation of the vibratoable MDD generator is assembly 124-000318. On this assembly the delayed vibrato circuitry (Q1,Q2,R1,R2,R3,R4,R5,R6,R7, D1,C1, and C2) and the Portamento resistor (R21) are removed. This assembly is used on organs not requiring delayed vibrato or Portamento capabilities.

The 124-000318 MDD assembly is completely interchangeable with the 124-000265 MDD assembly.

MDD Generator

Components not "boxed-in" by dotted lines are common to both the assemblies. IC1 is a signa divider; it is used to insure a square input signal with a 50 per cent duty cycle to drive the MDD IC packages. This divider (IC1) may b driven by either the crystal oscillator or the vibratoable oscillator. The -5 volts for this IC is generated by D6 and R36 and bypassed by C15.

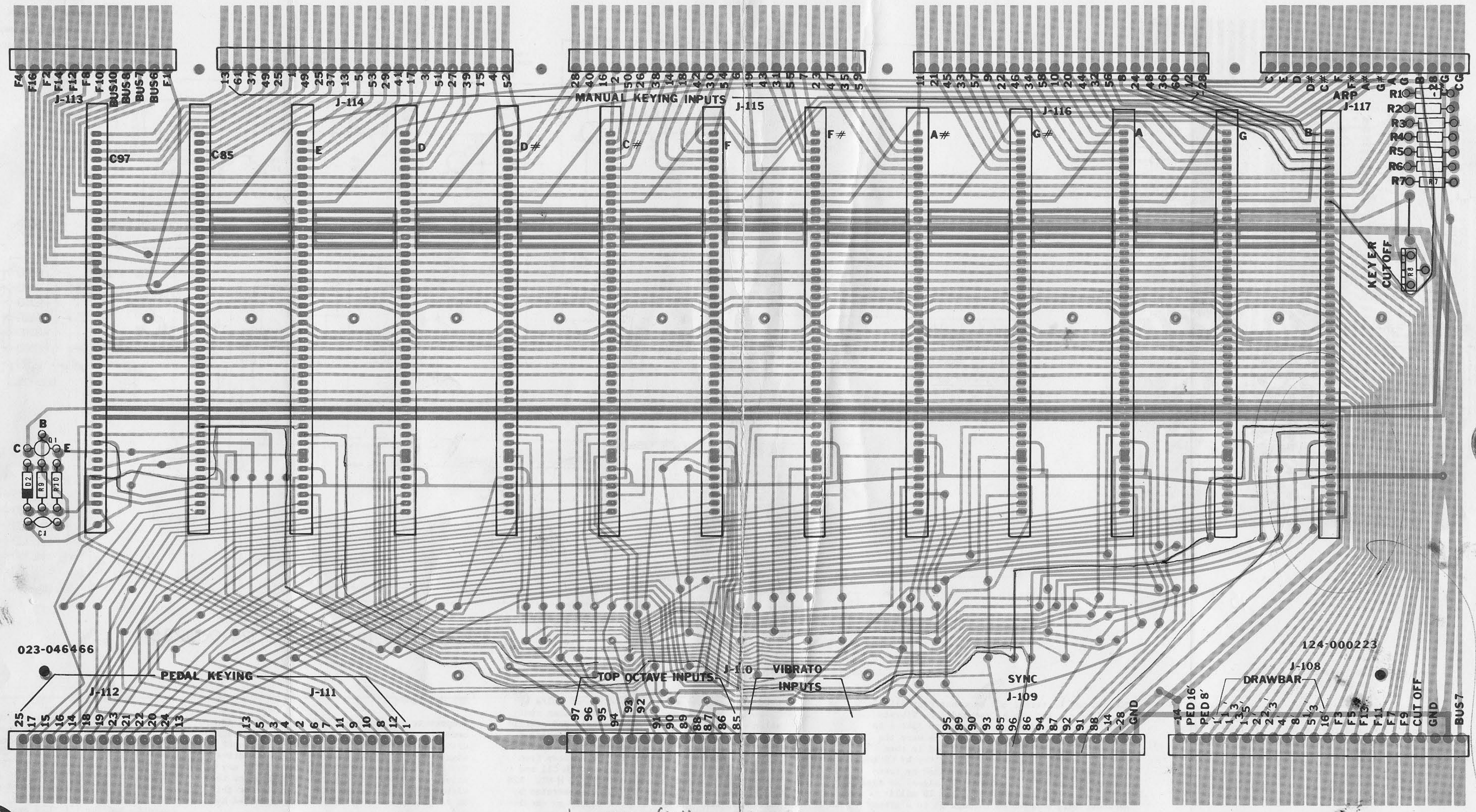
IC2 and IC3 are the two MDD frequency generators; IC2 generates frequencies F92 through F97 and F85. IC3 generates frequencies F86 through F91. IC1 drives buffer Q9, supplying an 11 volt 1.99936 M HZ. clock signal for the MDD packages. Diodes D10 and D11 supply protection for the clock input gates on the MDD packages.

Three power supplies, -11 volts, -16 volts, and -28 volts, are required for the operation of the two MDD packages. The -28 volts is supplied from the organ power supply. The -16 volts supply is generated by two diode drops (D8,9) from -14 volts through R37 to -28 volts. R40 and R41 form a voltage divider between ground and -14 volts to generate the -11 volt supply. (The -11 volt current, and the -16 volt supply may draw 24 to 70 MA.) Each of the three supplies is protected from static discharge by a capacitor (C21,22,23). The -16 volt supply is filtered by C20.

All outputs of the MDD generator IC packages are protected by a diode connected to -16 volts (diodes D12 to D24).

FIGURE 3-4
MDD GENERATOR BOARD
SCHEMATIC, LAYOUT
AND THEORY
(124-000266)

380



CK WITH AUDIO FROM FLTER

| INPUTS from MDD

②

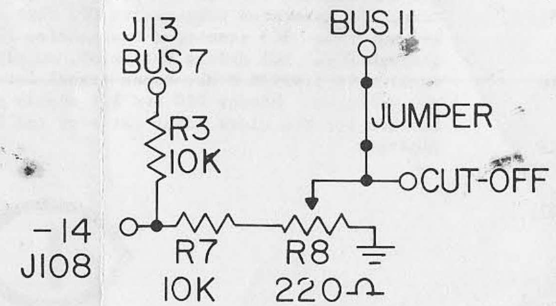
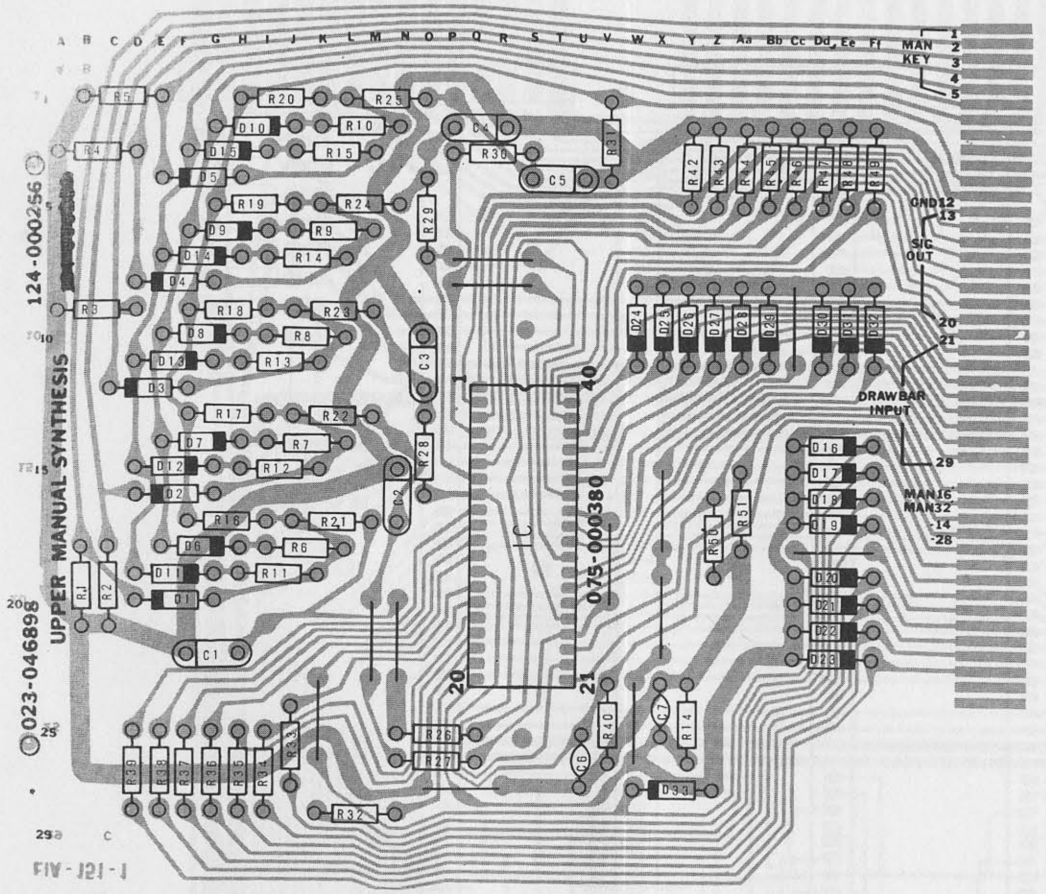


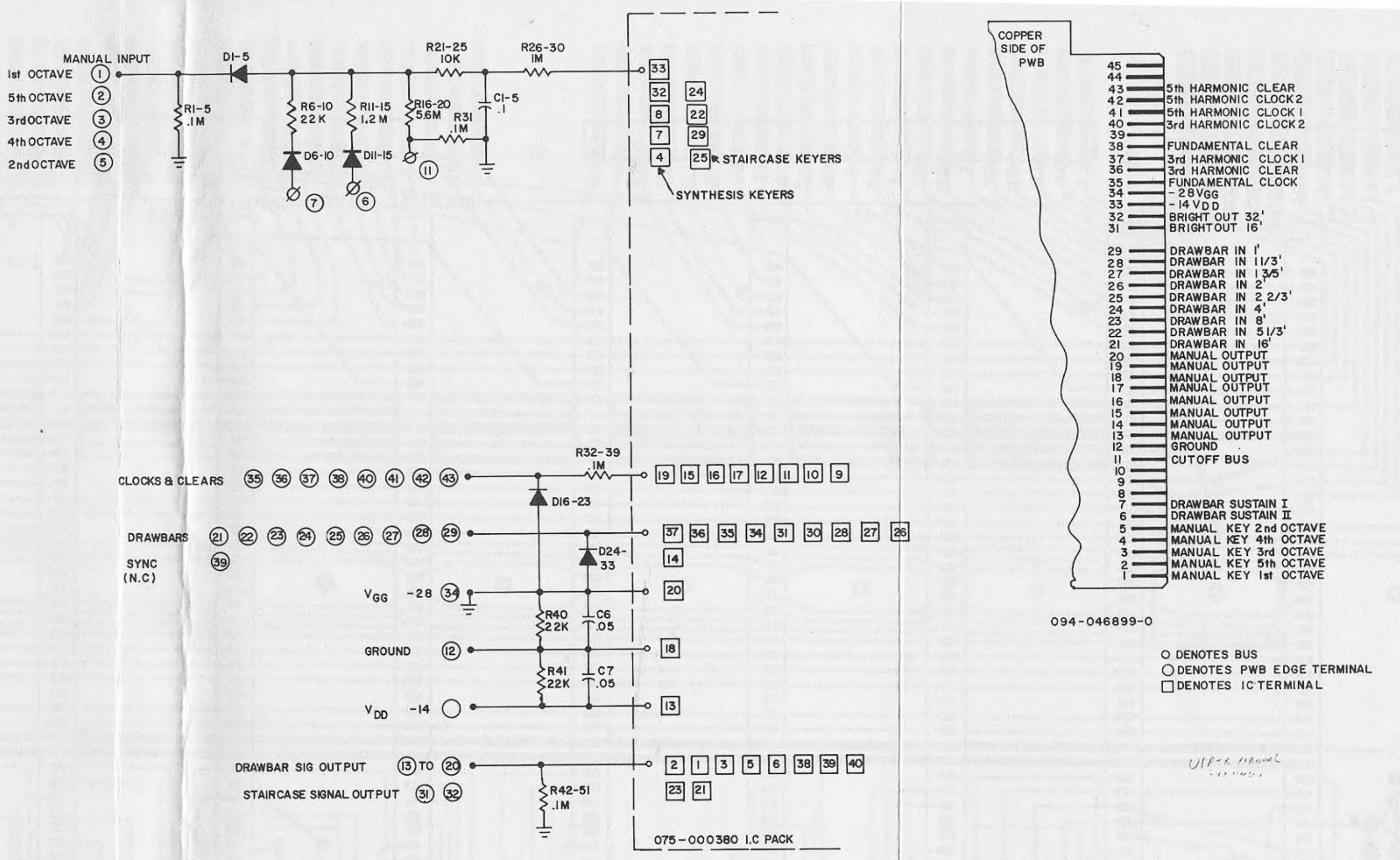
FIGURE 3-5
UPPER MANUAL SYNTHESIS
MOTHER BOARD-SCHEMATIC,
LAYOUT AND THEORY
(124-000223-002)

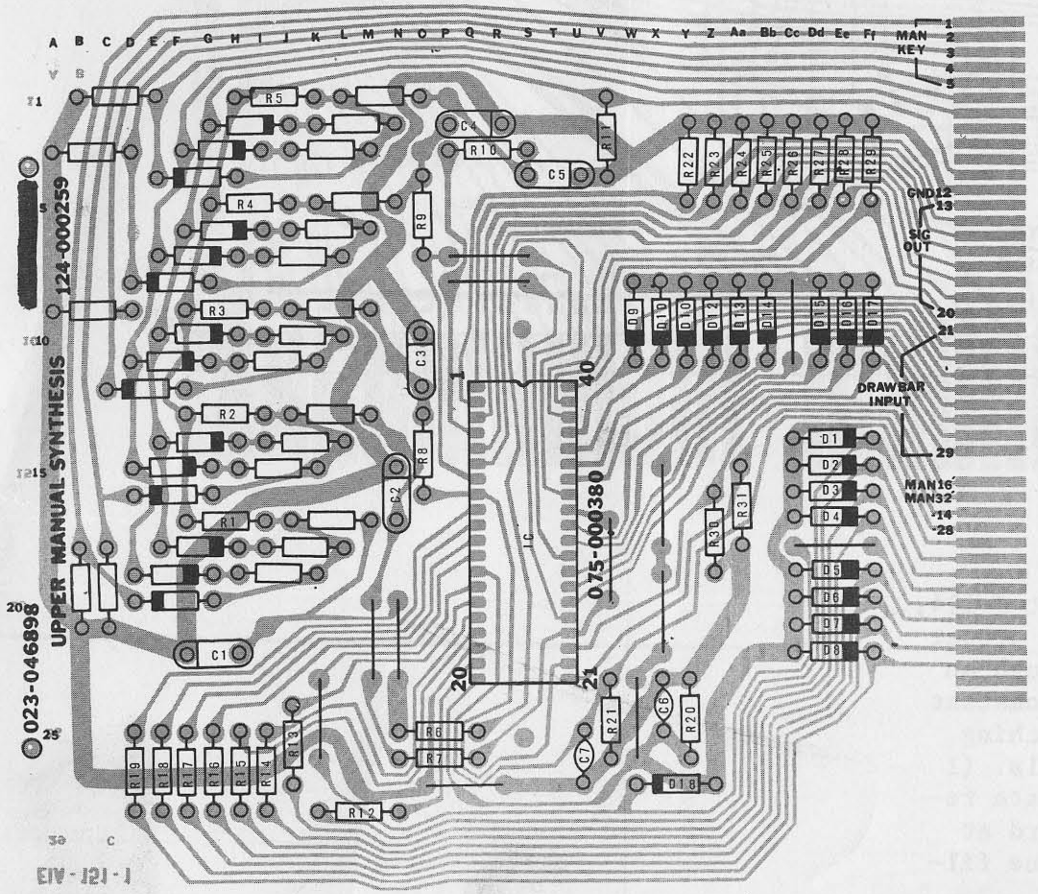
124-000222-002 UPPER MANUAL SYNTHESIS MOTHER BOARD

MDD signals (from 124-000266 board) enter at J-110, then go to one of 13 daughter boards (124-000223). A master pulse output from the Lower Manual Synthesis assembly (124-000223) is used to synchronize frequencies used on both manuals and as harmonics of several notes on the same manual, to prevent cancellation effects. When synchronizing output is missing, the odd harmonics (Black Tonebars) usually will not sound. The tonebar inputs (J108) come from the tonebar stop switches via the Preset Mother Board (124-000243). This negative D.C. voltage adjusts the keyer supply voltage and therefore the square-wave output current. To minimize the interaction between keyers feeding the same filter, the input impedance of the filter is 100 ohms or less. Therefore, the output voltage at the filter terminals (J108 and J113) is very low when the filters are connected. A keyer cut-off control near J117 adjusts the decay limit of the keying voltage during sustain. J114, J116, and J117 are marked with key numbers. These are the upper manual outputs.



③





④

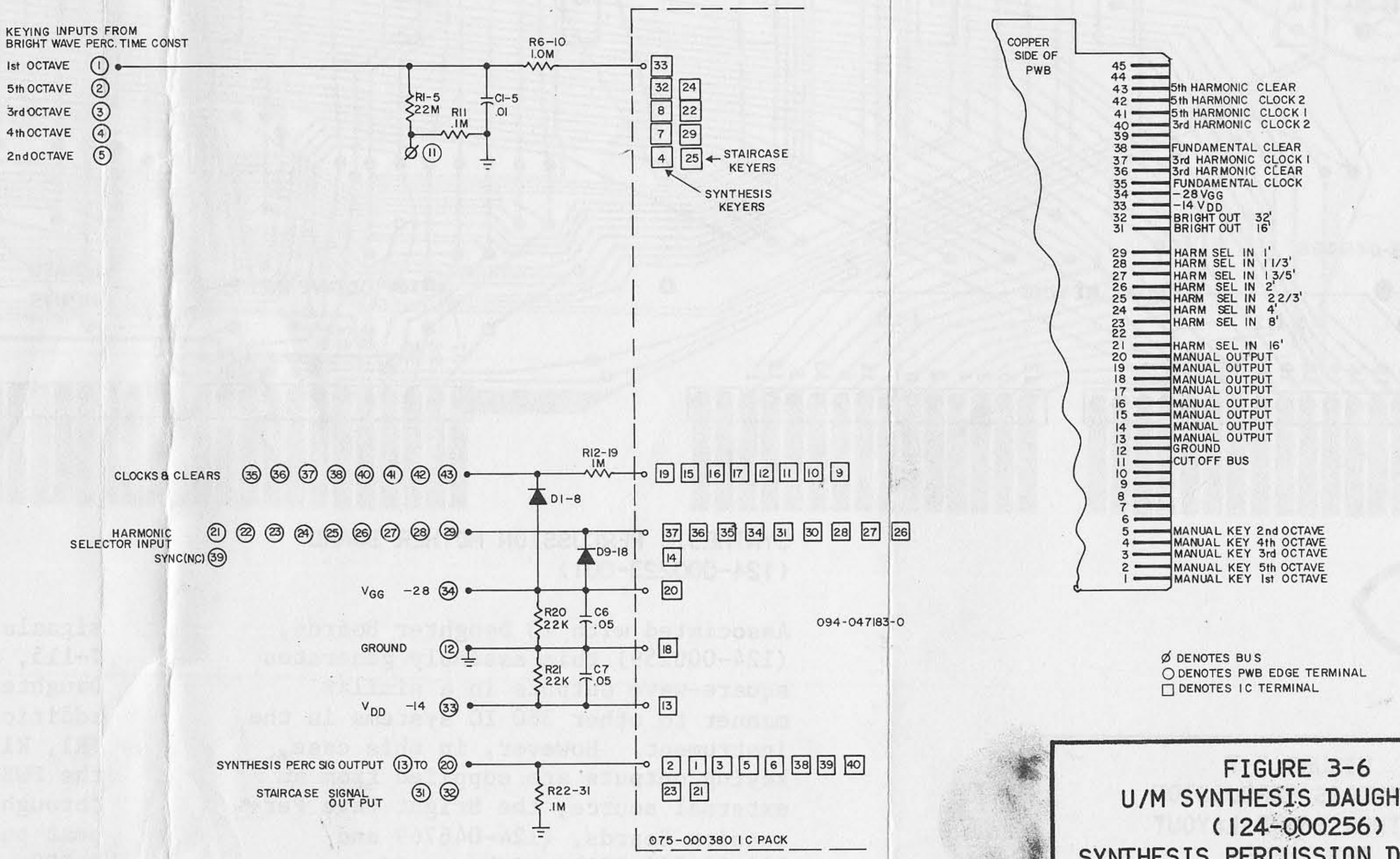
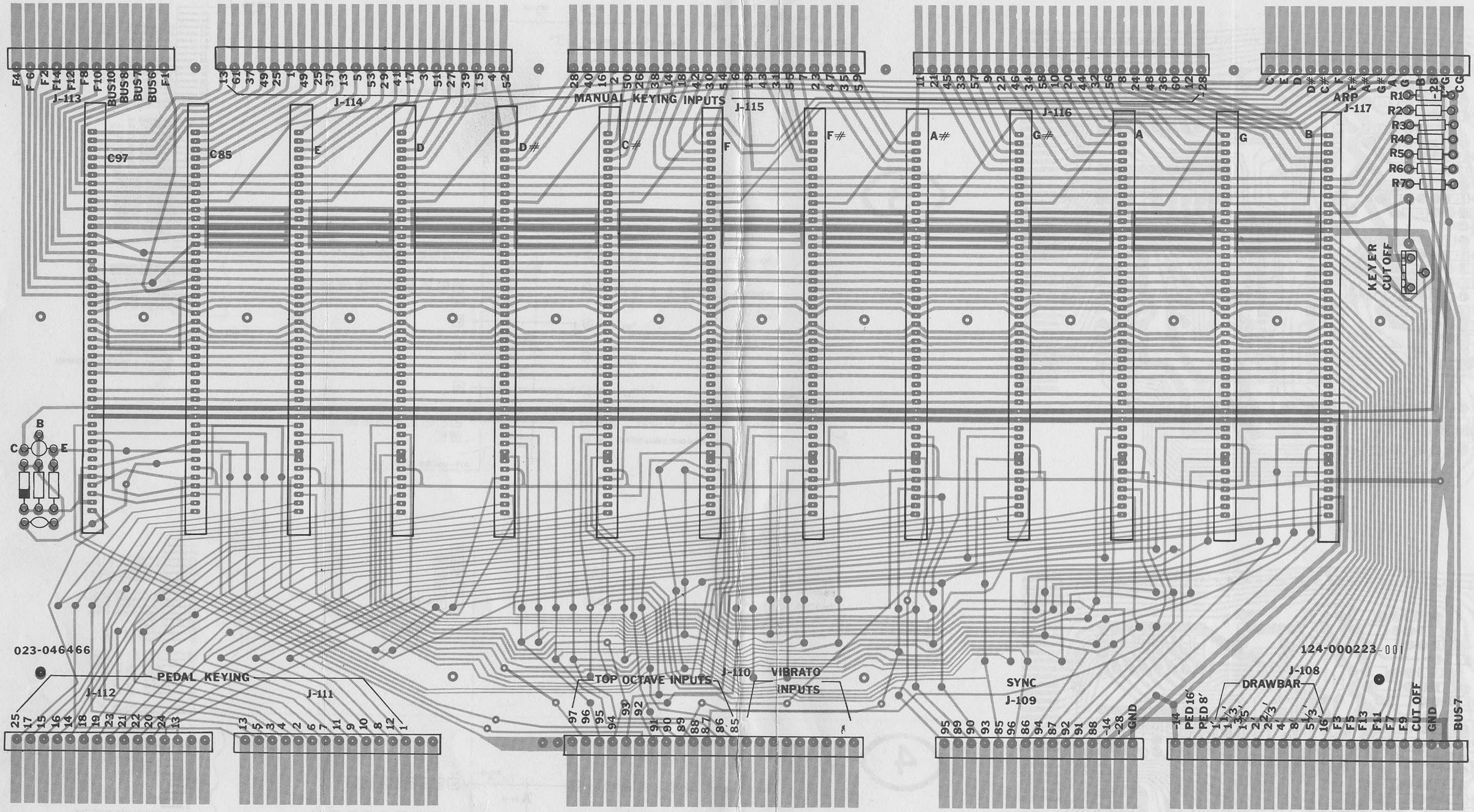


FIGURE 3-6
U/M SYNTHESIS DAUGHTER BD.
(124-000256)
SYNTHESIS PERCUSSION DAUGHTER BD.
(124-000259)

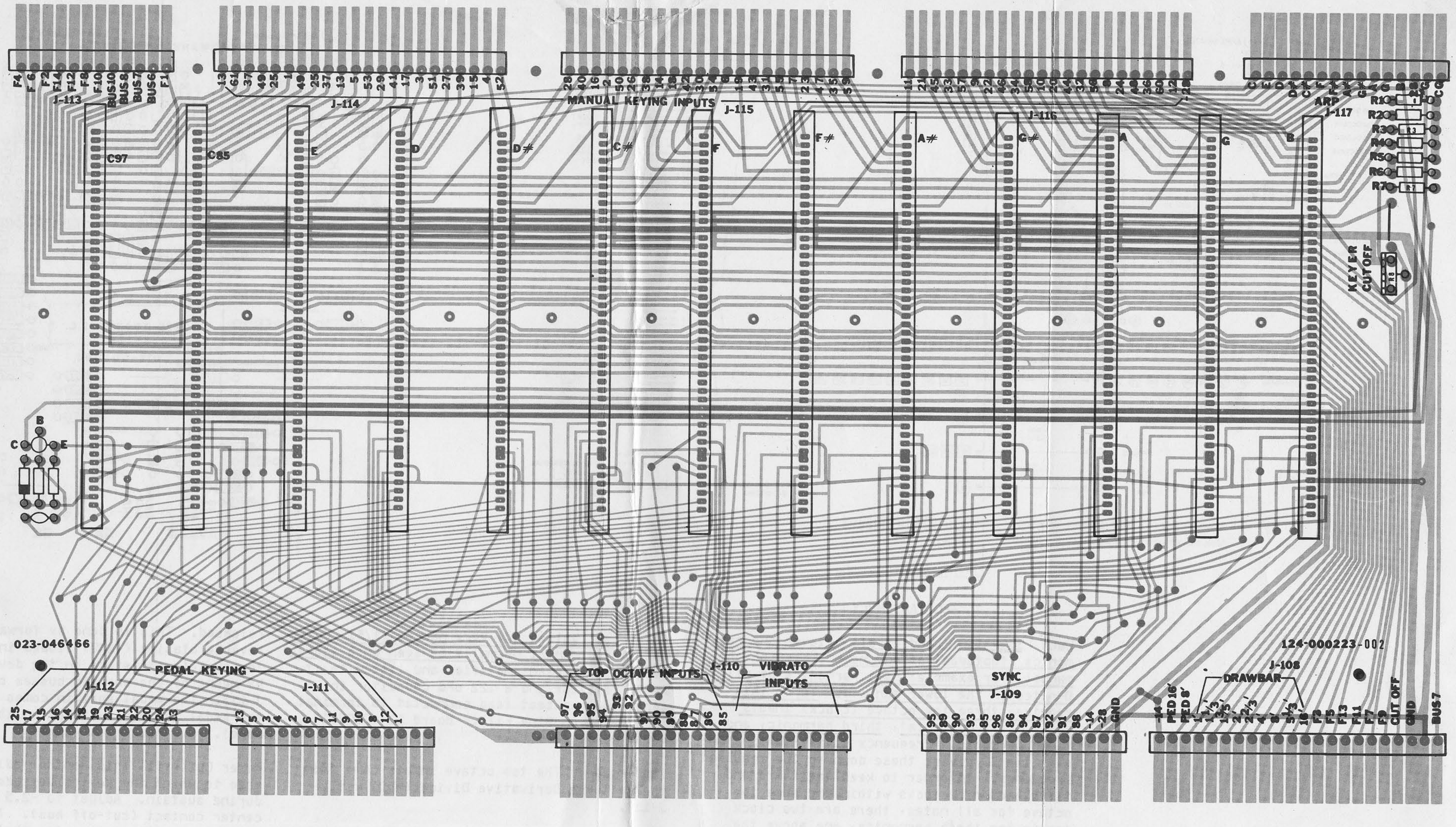


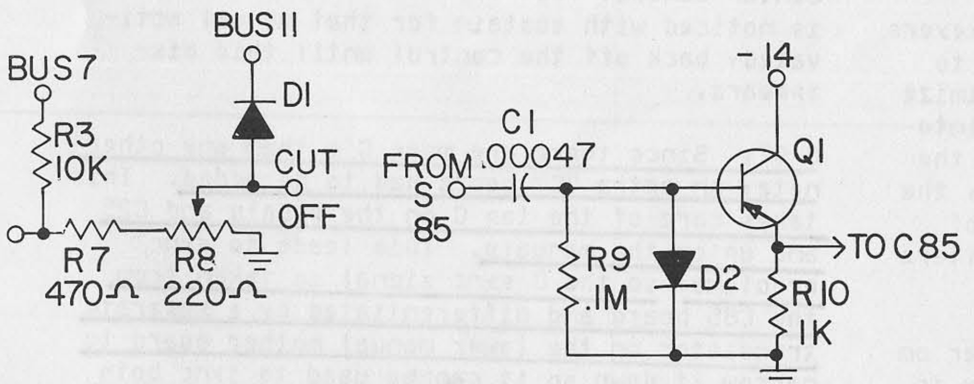
⑤

FIGURE 3-7
SYNTHESIS PERCUSSION
MOTHER BOARD-LAYOUT
AND THEORY
(124-000223-001)

SYNTHESIS PERCUSSION MOTHER BOARD (124-000223-001)

Associated with 13 Daughter Boards, (124-000259) this assembly generates square-wave outputs in a similar manner to other 380 IC systems in the instrument. However, in this case, keying outputs are supplied from an external source, the Bright Wave Percussion Boards, (124-046769 and 124-046769-001) which provide a percussion envelope as well. These signals enter Mother Board at J-114, J-115, and J-116, then go to proper Daughter Board, passing through an additional percussion time constant (R1, R11, C1, R6) before reaching the PWB octave input terminals. (1 through 5) repeat and alternate repeat pulses enter Mother Board at J-108. Signal outputs to sine filters are at J-113.





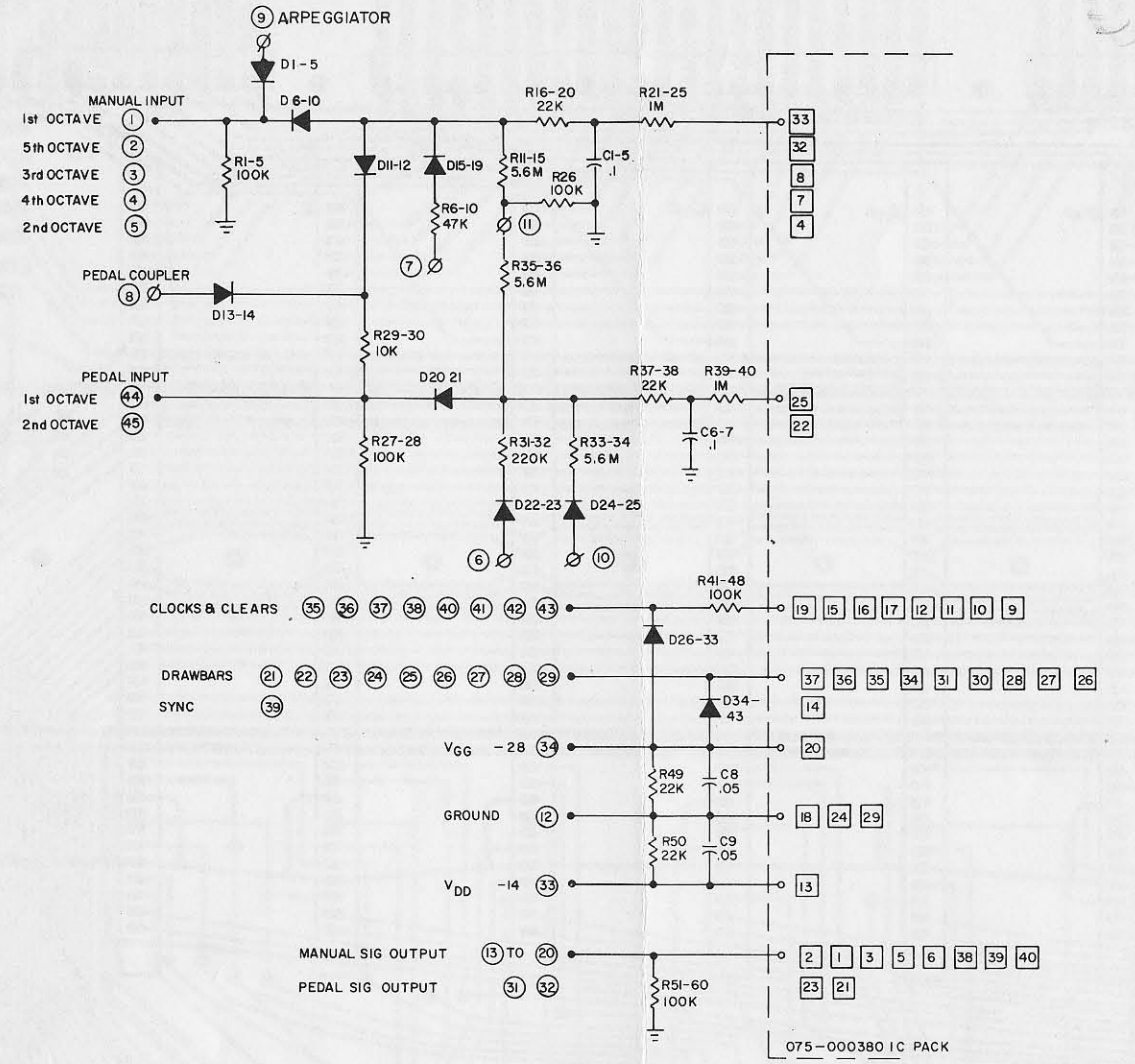
CLEAR 85 CIRCUIT

123-000223 LOWER MANUAL SYNTHESIS MOTHER BOARD

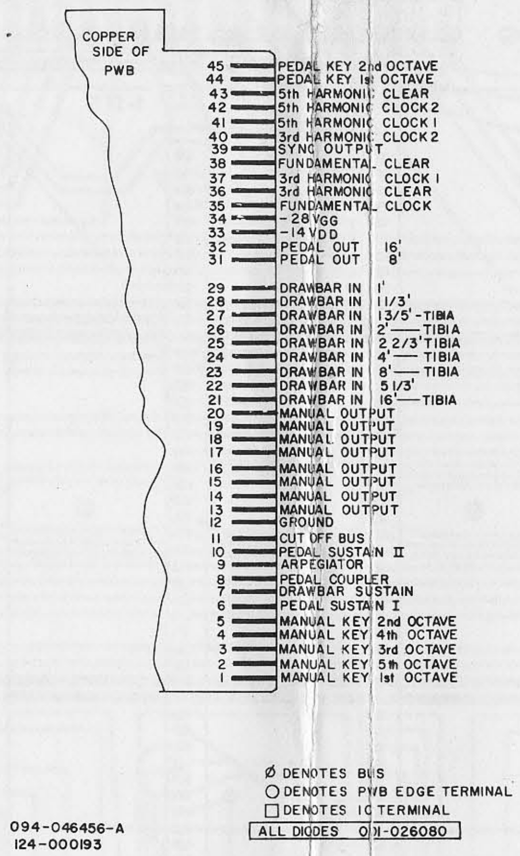
The action of the Lower Manual Synthesis assembly is in many respects, the same as the other "380" components, it has some additional functions, however, such as: 1. Pedal keying, utilizing the stair-step-wave outputs on the "380" IC's. 2. Producing a pulse signal output at J109 for the synchronization of all generator keyers, and 3. Providing inputs for the Arpeggiator keyboard, (124-047850) at J117. J111 and J112 are outputs to Pedal Filter Board (124-000206). There is no synthesis or bright percussion available on the lower manual.

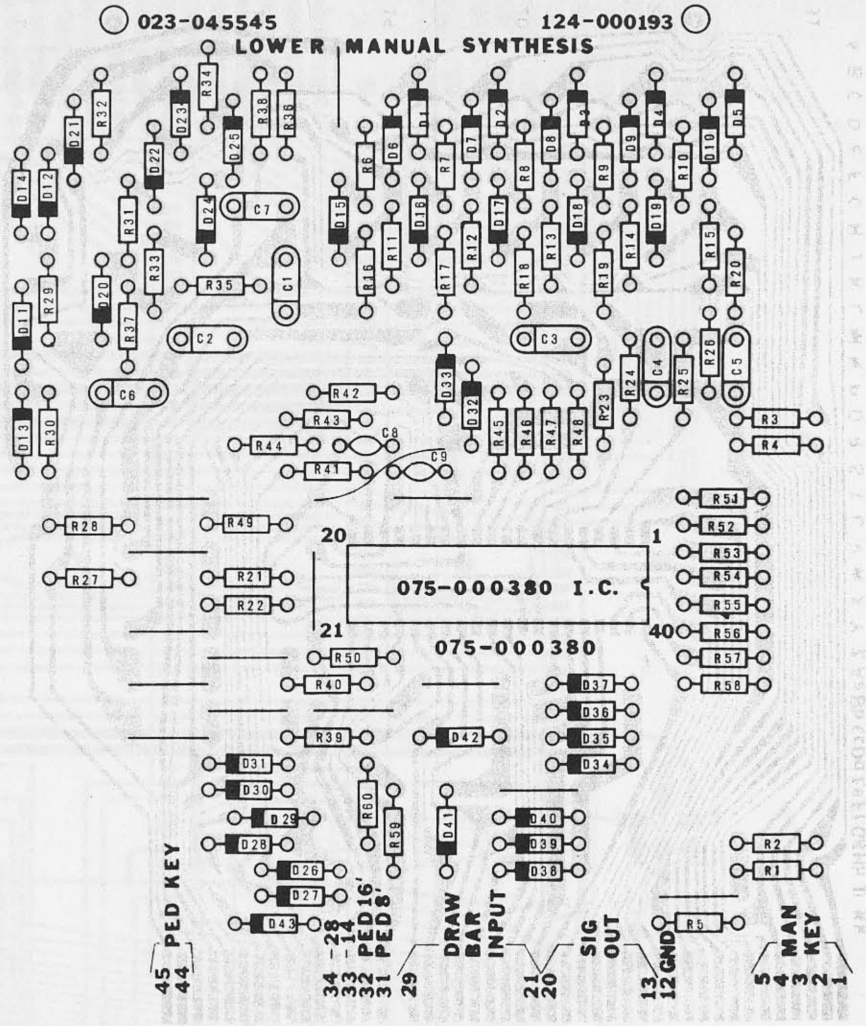
6

FIGURE 3-8
LOWER MANUAL SYNTHESIS
MOTHER BOARD - LAYOUT
AND THEORY
(124-000223)



"380" ASSEMBLY





Each "380" I.C. handles all octaves and harmonics (footages) of one note letter on one manual (for example: all harmonics of all D-notes on the lower manual). To do this requires three top octave (clock) inputs per I.C.: fundamental, third harmonic, and fifth harmonic. Frequency divider chains inside the IC, divide these down to the required frequency. In order to keep the third and fifth harmonic clocks within the same top octave for all notes, there are two clock inputs for these harmonics, one above the fundamental, and the other below. Only one of these is used for a particular note.

Sync: Since the same frequency is used on both manuals and as harmonics of other notes on the same manual, these frequencies must be locked together in phase to prevent possible cancellation effects. This sync output is obtained from the lower manual assembly which acts as a master and applied to the other assemblies via the sync terminals. (J-109).

These sync pulses are very narrow (1/512 duty cycle) and cannot normally be seen on a scope. Feed this into an amplifier and listen to it. A 47K resistor and a .22 uFd capacitor in series with a test lead connected to terminal 11 of J101 on Sine Filter Board 124-000201 works well.

Top Octave: The top octave inputs come from the Multiple Derivative Divider(MDD) via J-110.

Filter:Since the outputs of the manual keyers are square waves, they must be filtered to produce the desired sine waves. To minimize the interaction between keyers feeding into the same filter, the input impedance of the filters is made 100 ohms or less. Thus, the output voltage at the filter terminals of J-108 and J-113 is very low when the filters are connected.

Sustain: Sustain causes a note to linger on for a short period of time after the key is released. This is done by forward (0V) or reverse biasing (-14V) diodes in series with the sustain resistors on the daughter boards by means of the sustain busses on J-108 and J-113. The pedal sustain comes directly from the pedal sustain switches on the control panel.

Keyer Cut Off: This control adjusts the voltage to which the keying voltage decays during sustain. Adjust to -2.5 volts at the center contact (cut-off bus). If ciphering is noticed with sustain for that manual activated, back off the control until this disappears.

C 97: Since there are more C's than any other note, an extra "C" board had to be added. This takes care of the top C on the pedals and C25 and up on the manuals. This leads to sync problems, so the C sync signal is taken from the C85 board and differentiated by a separate transistor on the lower manual mother board to narrow it down so it can be used to sync both "C" dividers.

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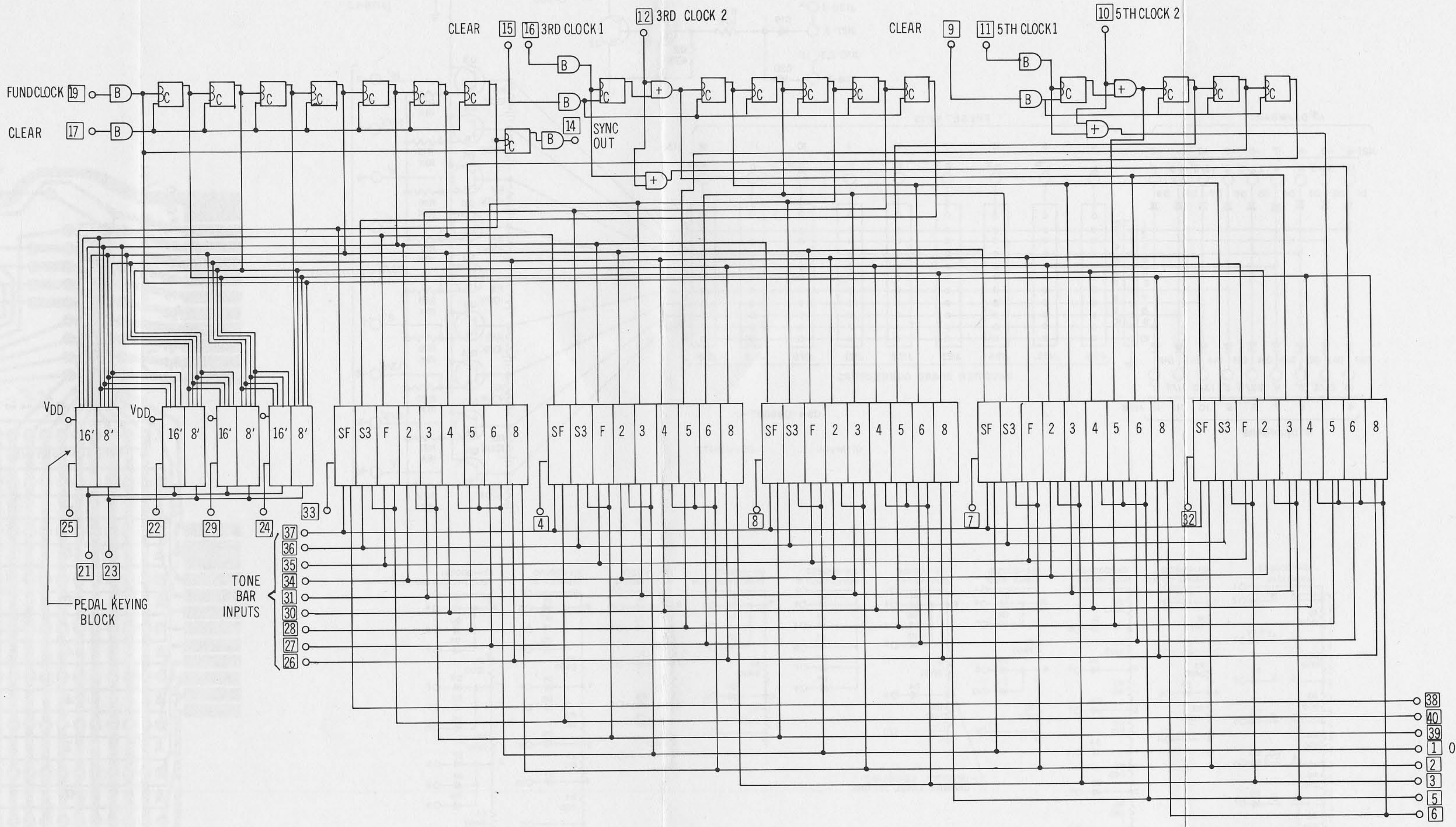
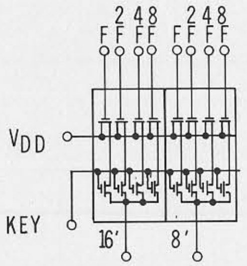
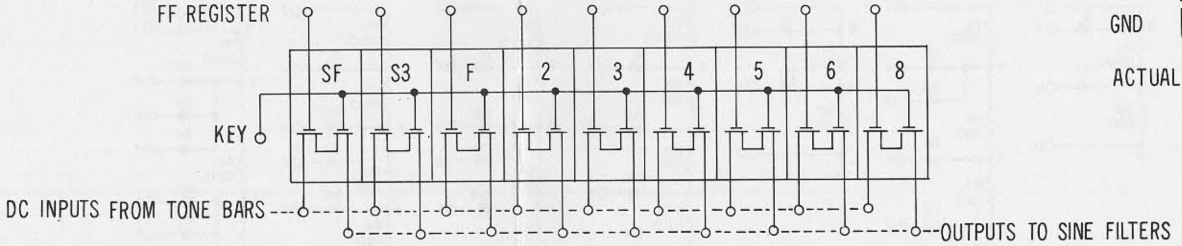
FIGURE 3-9
LOWER MANUAL SYNTHESIS
DAUGHTER BOARD-SCHEMATIC,
LAYOUT AND THEORY
(124-000193)





TYPICAL PEDAL KEYING BLOCK



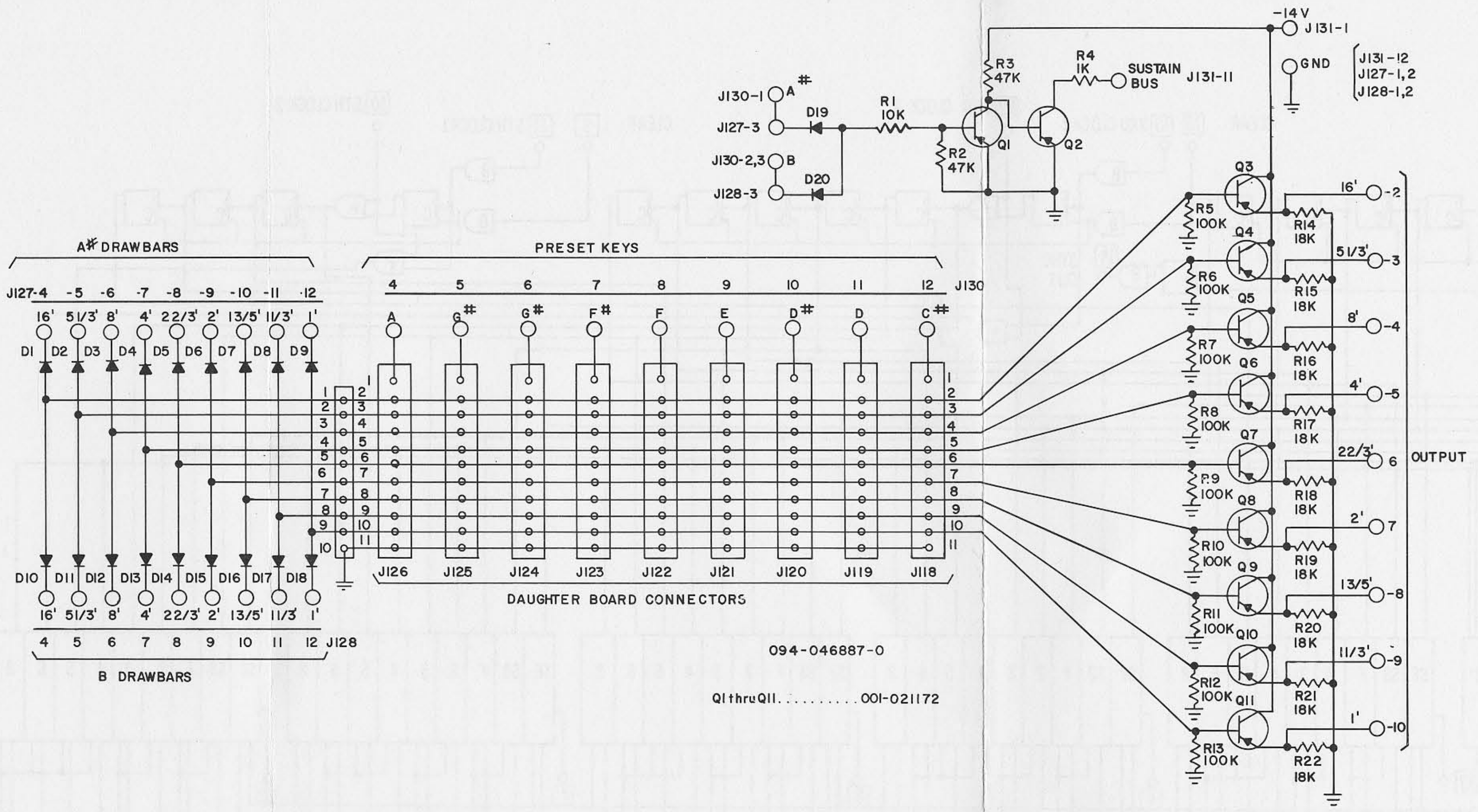
TYPICAL SYNTHESIS KEYING BLOCK

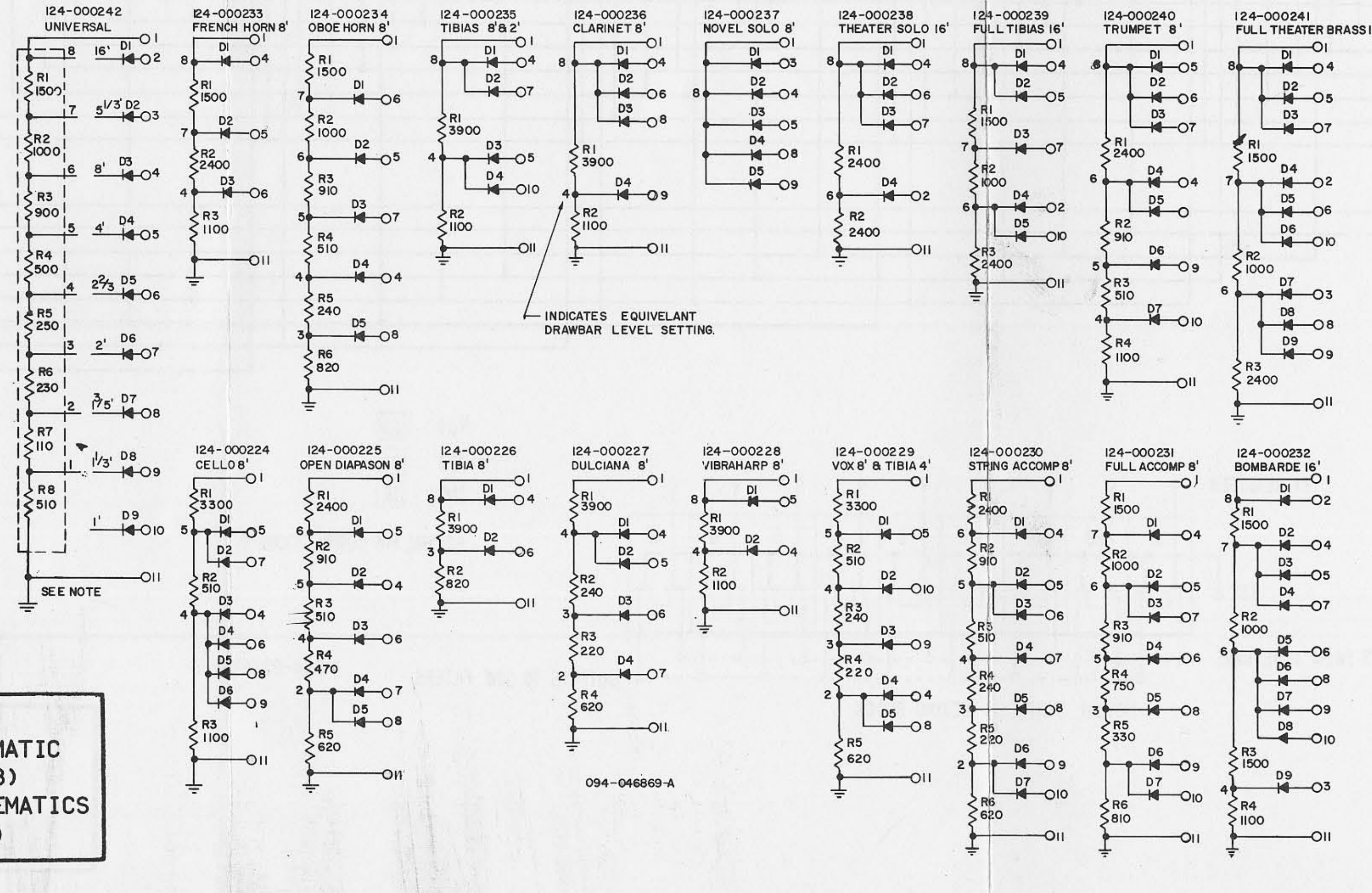
V_{DD}	13
V_{GG}	20
GND	18

ACTUAL PIN CONNECTIONS ☐

094-000380—D

FIGURE 3-10
I.C. 380 DIVIDER
KEYER PACKAGE-SCHEMATIC
(075-000380)





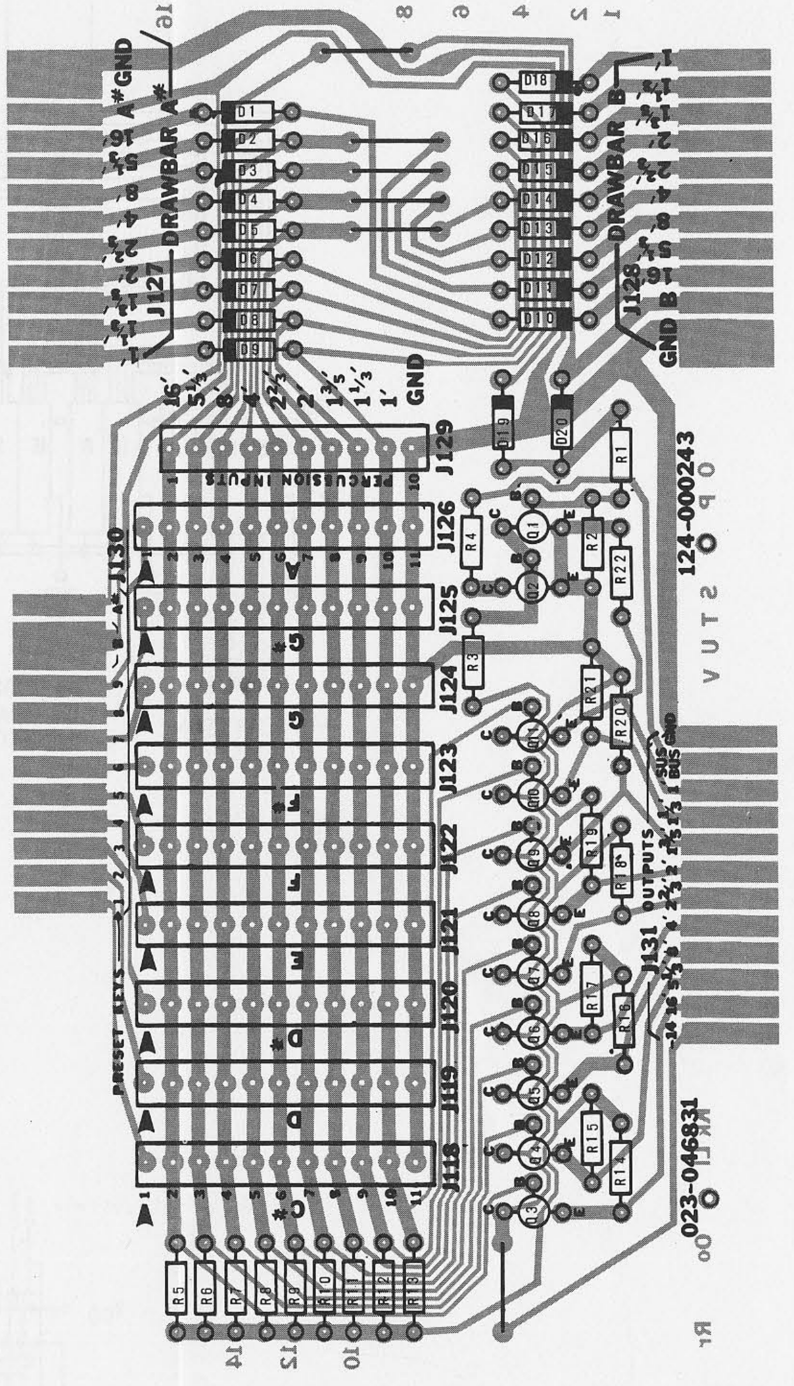


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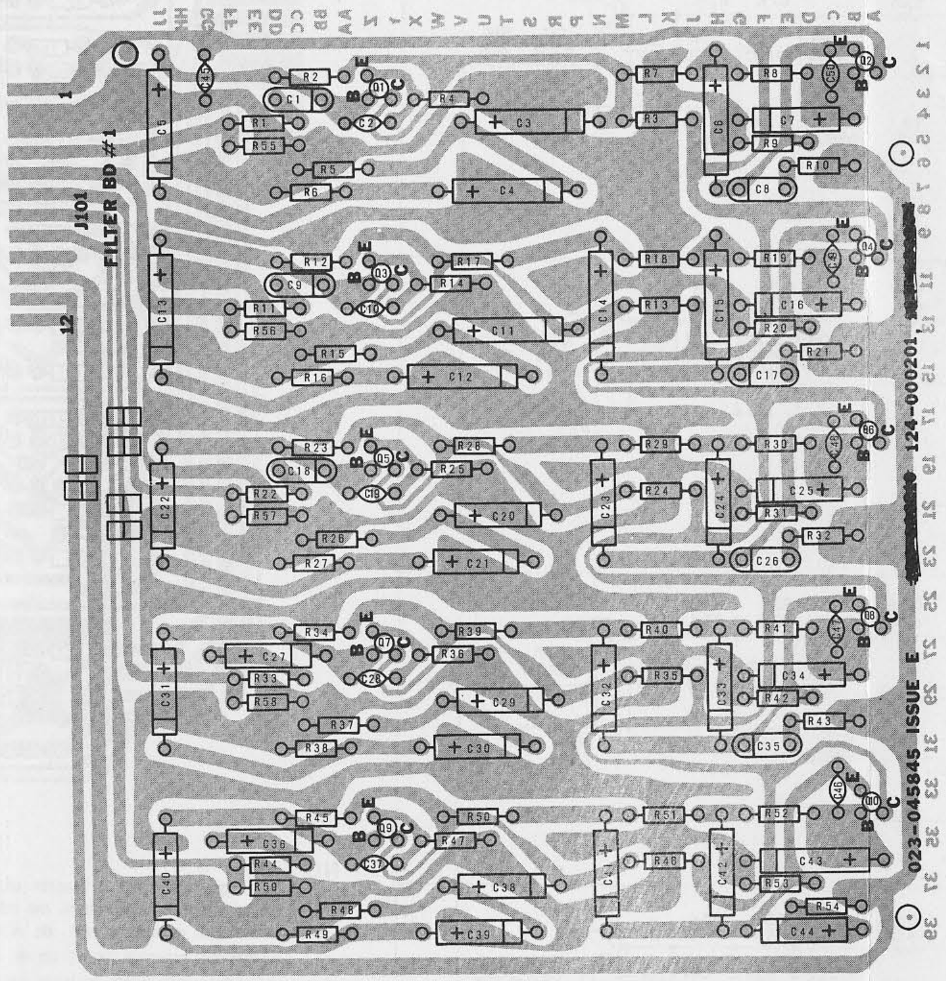
FIGURE 3-11
PRESET MOTHER BOARD-SCHEMATIC
AND LAYOUT-(124-000243)
PRESET DAUGHTER BOARDS-SCHEMATICS
(124-000224 THRU 242)



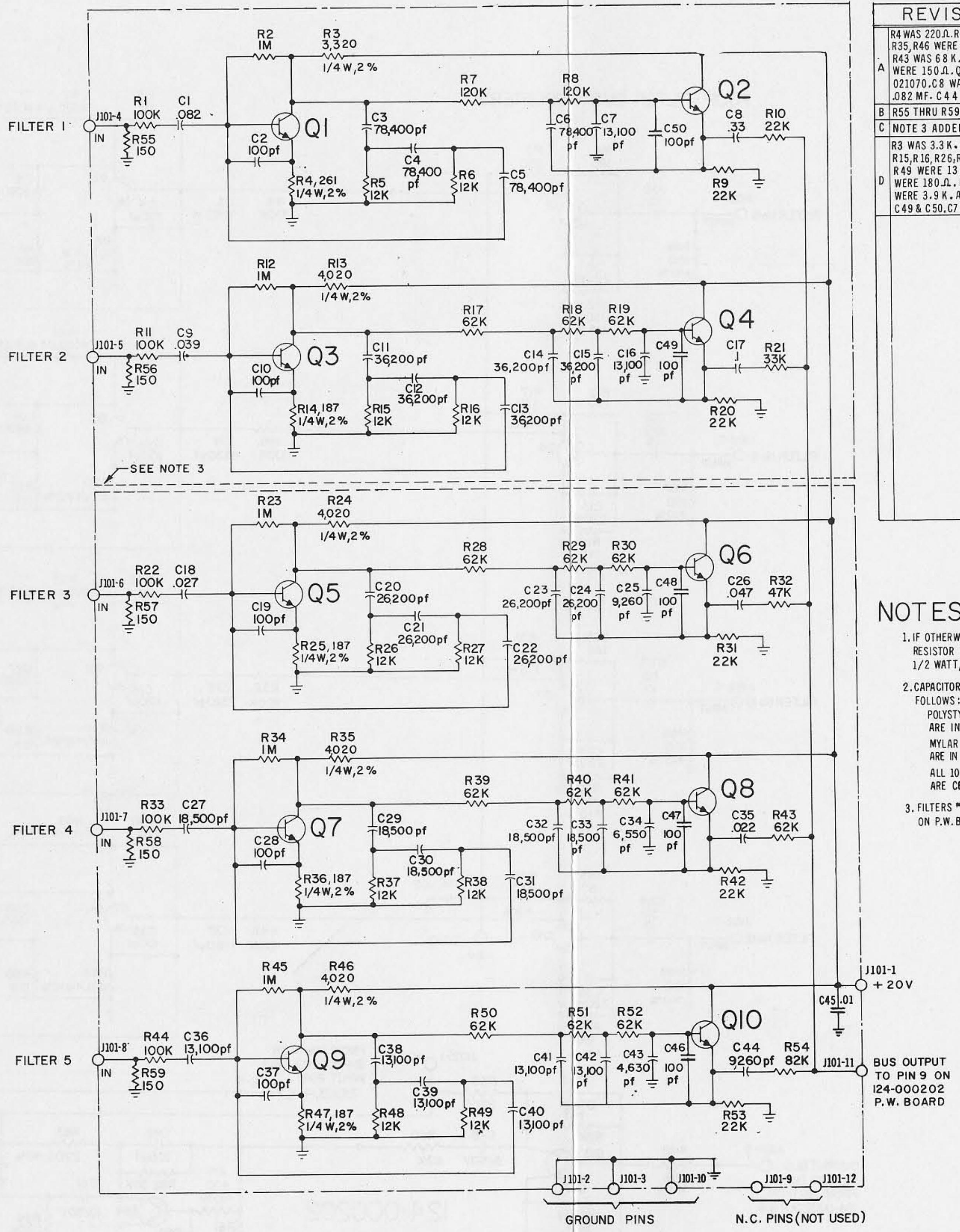
124-000201, 124-000202, 124-000204.

SINE WAVE FILTER BOARDS.

These printed wiring boards work together as a unit. There are 14 filter groups in each set to match the 14 signal output terminals of a typical 380 assembly. Each group passes one 12 interval octave plus one note, with the exception of group #1, which is for frequency #1 thru #12 only. Pass bands of the filter groups overlap by necessity due to the combination of pitches on the 380 outputs. A total range of 8 octaves is available. (frequency #1 thru #97). On the first five groups, a 150 ohm resistor is used at the input to develop the square wave output current from the 380 keyers into a signal of approximately 80 mv peak to peak for one note at tonebar position 8. On all remaining groups the keyer current is summed in a bus amplifier input of very low impedance (10 ohms). The output current at the collector of this stage is the same amplitude as is developed across the 150 ohm resistors on the first five groups. The bus amp is used to prevent IM distortion from interaction between the IC keyers. It is not needed on the lower frequency groups because the IM difference frequencies are most sub-audible. Most of the filter groups are two stage, 8 pole, active band-pass filters. The first stage has a pronounced peak near the top of the pass band. The second stage starts the roll-off just above the low end of the pass band, a combination which provides a reasonably flat pass-band with a sharp attenuation curve. Input and output coupling capacitors are used to reduce keying thumps by providing low frequency roll-off. Filter group #1 has one RC section deleted as the sine wave purity requirements are not as severe at low frequencies. Filter group #14 has only one stage since the harmonics are at the upper limit of hearing. All signals from the 124-000201 and 124-000204 boards go to the 124-000202 board where Q13, a phase diverter, sums the outputs of groups one ghru five which do not have bus amplifiers. The remaining signals along with those from the phase inverter feed into Q14, an output amp on the 124-000202 board. Mixing resistors in the output of each filter group are selected to provide the necessary tapering. (Higher output at lower frequencies).

TVI suppression capacitors are provided and isolating resistors are used to prevent failure of the output amp or the phase inverter.

NOTE: Earlier versions of these boards do not have TVI suppression capacitors of isolation resistors.



	REVISIONS
A	R4 WAS 220Ω. R10 WAS 27K. R13, R24, R35, R46 WERE 3.3K. R21 WAS 39K. R43 WAS 68K. R14, R25, R36, R47 WERE 150Ω. Q5, Q7, Q9 WERE 001-021070. C8 WAS .27 MF. C17 WAS .082 MF. C44 WAS 13,100 PF.
B	R55 THRU R59 WERE 100Ω.
C	NOTE 3 ADDED.
D	R3 WAS 3.3K. R4 WAS 270Ω. R5, R6, R15, R16, R26, R27, R37, R38, R48 & R49 WERE 13K. R14, R25, R36, R47 WERE 180Ω. R13, R24, R35, R46 WERE 3.9K. ADDED C46, C47, C48, C49 & C50. C7 CONNECTED TO GROUND.

NOTES:

1. IF OTHERWISE NOT SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ± 5 %.
2. CAPACITOR VALUES ARE, AS FOLLOWS:
   POLYSTYRENE CAPACITOR VALUES ARE IN PICOFARADS, ± 2.5 %;
   MYLAR CAPACITOR VALUES ARE IN MICROFARADS, ± 10 %;
   ALL 100 PF CAPACITORS & C45 ARE CERAMIC, ± 10 %.
3. FILTERS #1 & #2 ARE NOT USED ON P.W. BOARD 124-000310.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
5	Q1, Q3, Q5, Q7, Q9	001-021260	2N5826
5	Q2, Q4, Q6, Q8, Q10	001-021135	2N3394

124-000201/124-000310

094-045849-D

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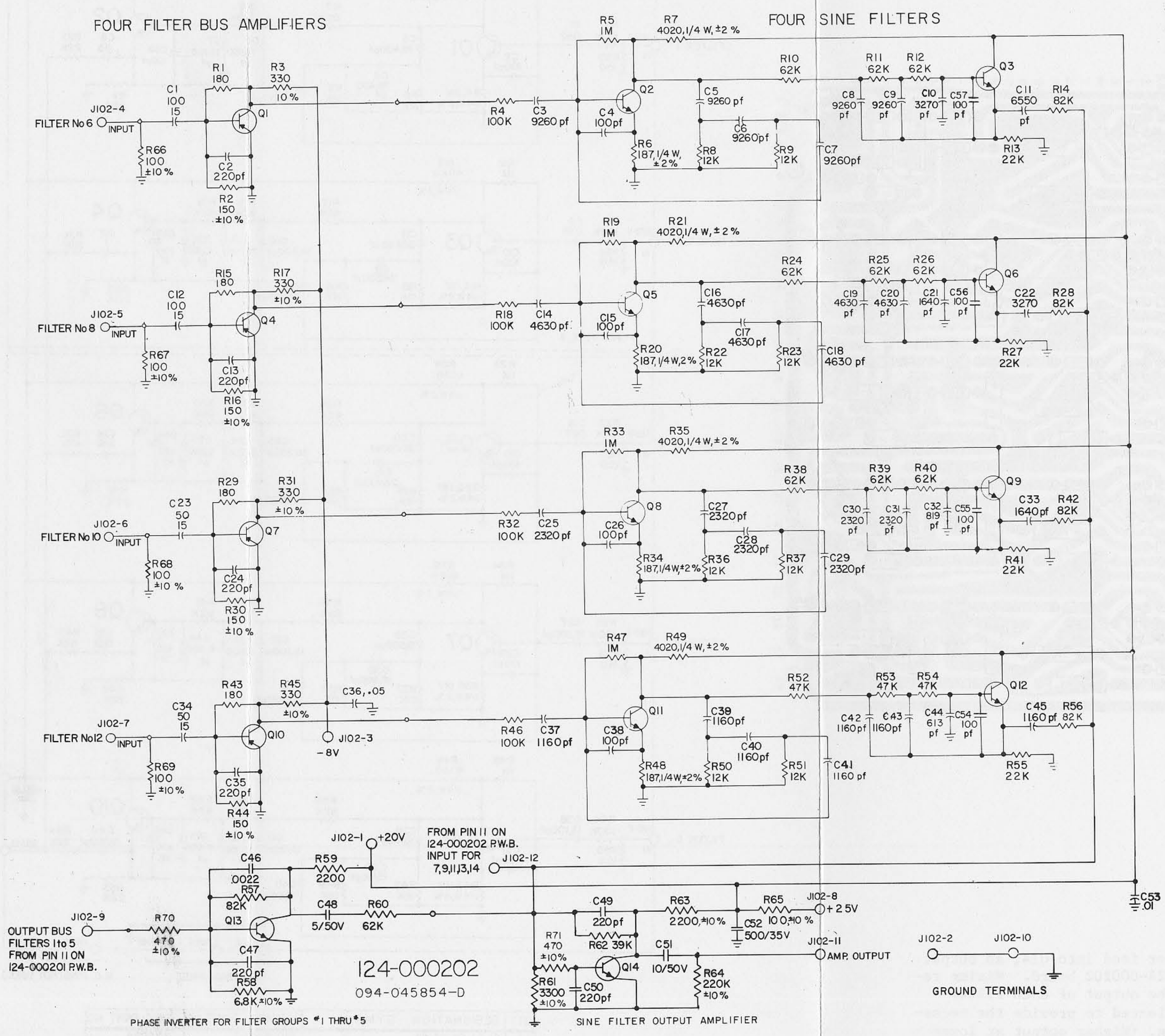
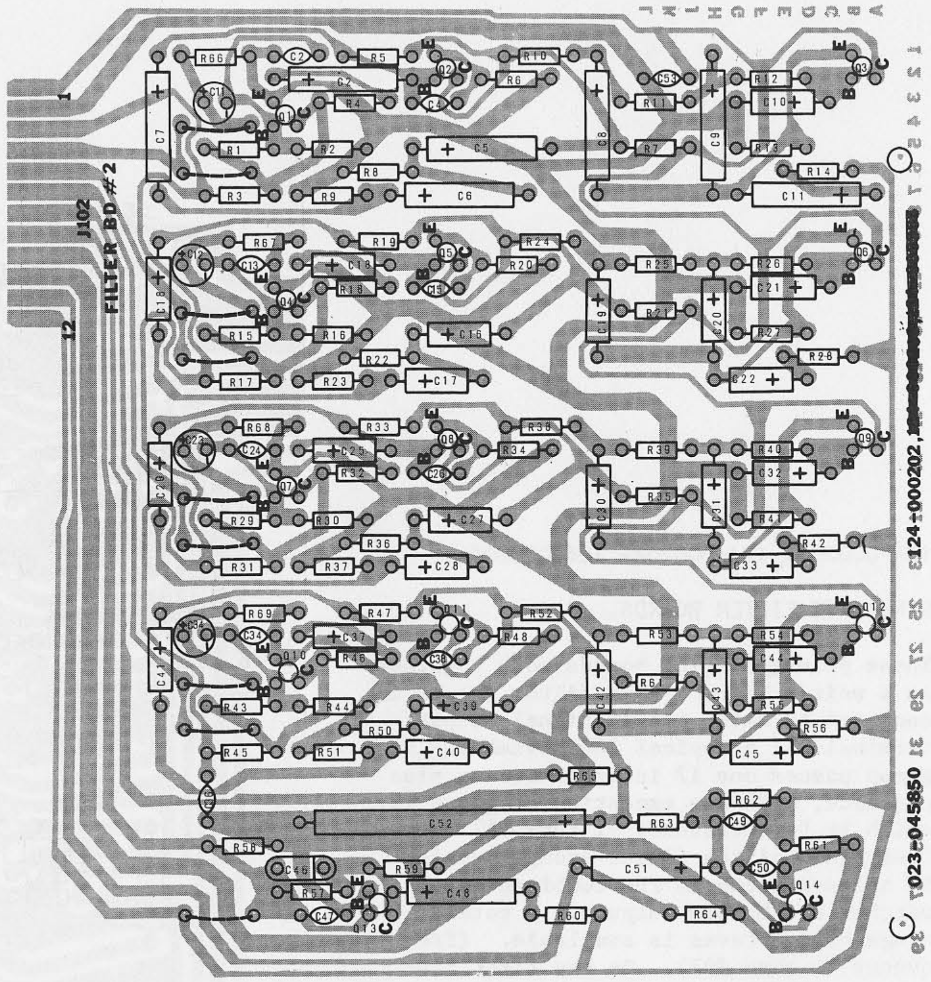
FIGURE 3-12
SINE WAVE FILTER #1
SCHEMATIC, LAYOUT AND
THEORY (124-000201)





NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±5%.
2. MYLAR CAPACITOR VALUES, ±10 % AND ELECTROLYTIC CAPACITOR VALUES, SHOWN WITH WORKING VOLTAGE, ARE IN MICROFARADS.
3. POLYSTYRENE CAPACITOR VALUES ARE IN PICOFARADS, ± 2.5%.
4. CAPACITORS WITH VALUES OF 100PF, 200 PF AND C53 ARE CERAMIC, ± 10%.

QTY	DESIGNATION SYMBOL	HAMMOND PART #	JEDEC PART #
4	Q1, Q4, Q7, Q10	001-021172	2N 4249
6	Q2, Q5, Q8, Q11, Q13, Q14	001-021260	2N5826
4	Q3, Q6, Q9, Q12	001-021135	2N 3394

REVISIONS	
A	"SPINETS ONLY" DELETED FROM NOTE 2.
B	R2,R16,R30 & R44 WERE 120 Ω. R7,R21,R35 & R49 WERE 3.3 K. R6,R20 & R34 WERE 150 Ω. R48 WAS 130Ω. R61 WAS 6800Ω. R62 WAS 82 K. Q2,Q5,Q8,Q11 WERE 001-021070. C49 WAS 100 PF. C11 WAS 9260 PF. C22 WAS 4630 PF. C33 WAS 2320 PF.
C	R1,R15,R29 & R43 WERE 120Ω. R2,R16, R30 & R44 WERE 330Ω.
D	ADDED C54 THRU C58. R6,R20,R34 & R48 WERE 180Ω. R7,R21,R35 & R49 WERE 3.9 K. R8,R9,R22,R23,R36,R37,R50 & R51 WERE 13K. R70 & R71 ADDED. Q13 & Q14 WERE 001-021135.

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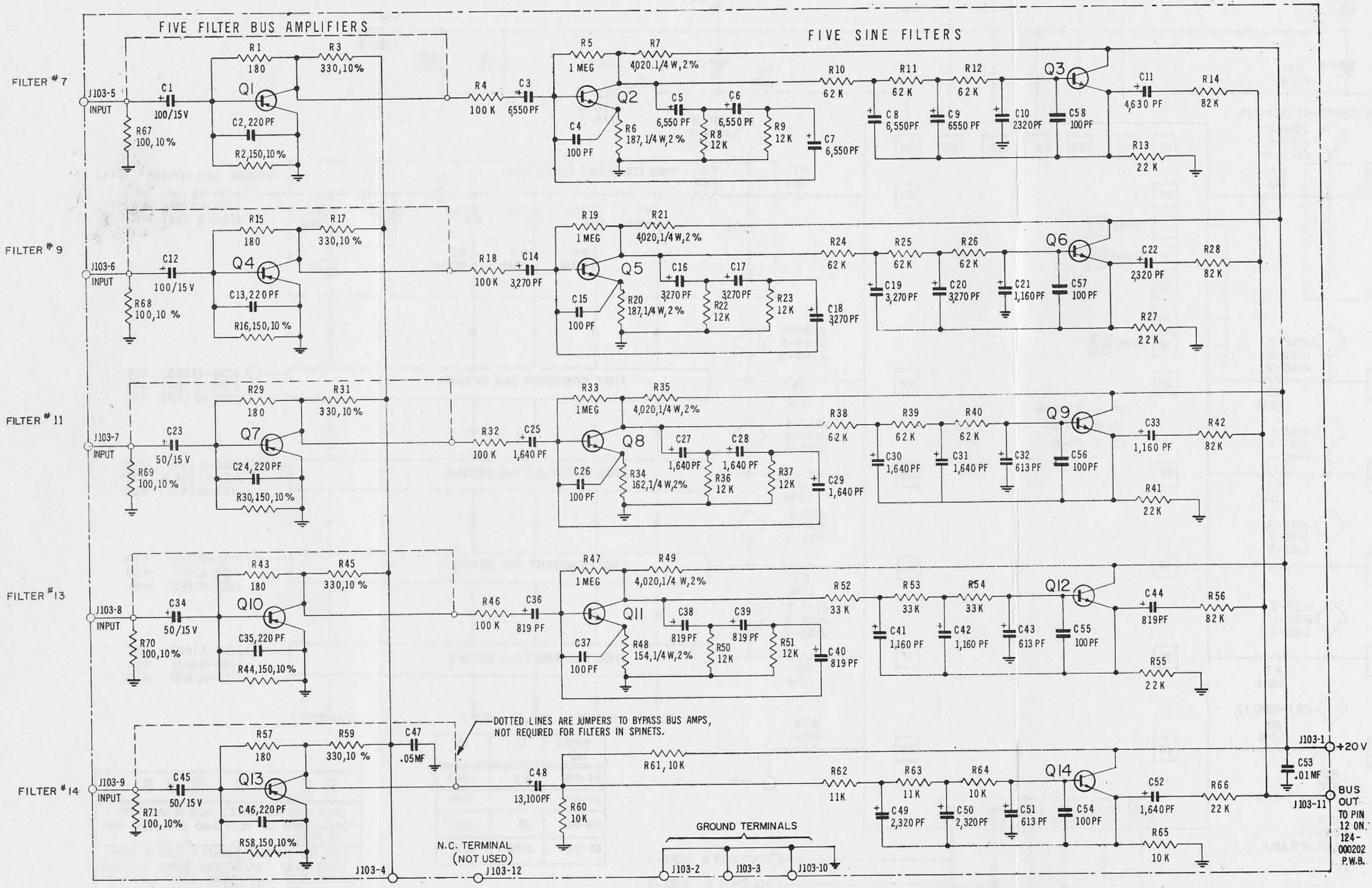
FIGURE 3-13
SINE WAVE FILTER #2
SCHEMATIC, LAYOUT
AND THEORY
(124-000202)

NOTE: FOR 124-000202 THEORY OF OPERATION SEE FIG. 3-12



DOTTED LINES ARE JUMPERS TO BYPASS BUS AMPS, NOT REQUIRED FOR FILTERS IN SPINETS.

NOTES:

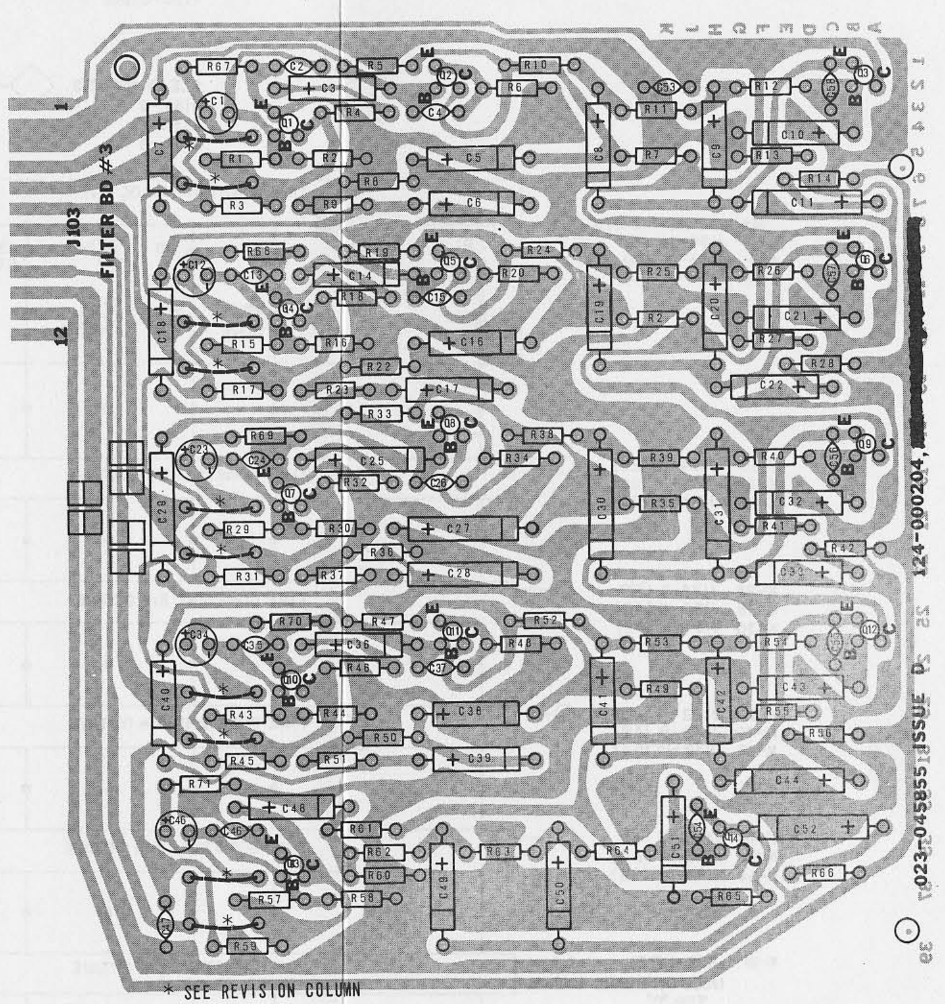
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±5 %.
2. CAPACITOR VALUES ARE AS FOLLOWS:
   MYLAR CAPACITORS, ± 10 % AND ELECTROLYTIC CAPACITORS WITH THEIR VALUES AND WORKING VOLTAGES SHOWN, ARE IN MICROFARADS;
   POLYSTYRENE CAPACITOR VALUES ARE IN PICOFARADS, ± 2.5 %;
   C53 AND ALL 100 PF & 220 PF CAPACITORS ARE CERAMIC, ± 10 %.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
5	Q1,Q4,Q7,Q10,Q13	001-021172	2N 4249
4	Q2,Q5,Q8,Q11	001-021260	2N 5826
5	Q3,Q6,Q9,Q12,Q14	001-021135	2N 3394

124-000204/124-000205

094-045859-C

REVISIONS			
A	R2,R16,R30,R44,R58 WERE 120Ω. R7,R21,R35,R49 WERE 3.3K. R6,R20,R34 WERE 150Ω. R48 WAS 120Ω. Q2,Q5,Q8,Q11 WERE 001-021070. C11 WAS 4,630 PF. C22 WAS 3,270 PF. C33 WAS 1,160 PF.	C	R21,R35,R49 WERE 3.9K. R34 WAS 160Ω. R48 WAS 150Ω. R8,R9,R22,R23,R36,R37, R50,R51 WERE 13K.
B	R1,R15,R29,R43,R57 WERE 120Ω. R2,R16,R30, R44,R58 WERE 330Ω.		
C	ADDED C54 THRU C58. R6 & R20 WERE 180Ω. R7,		

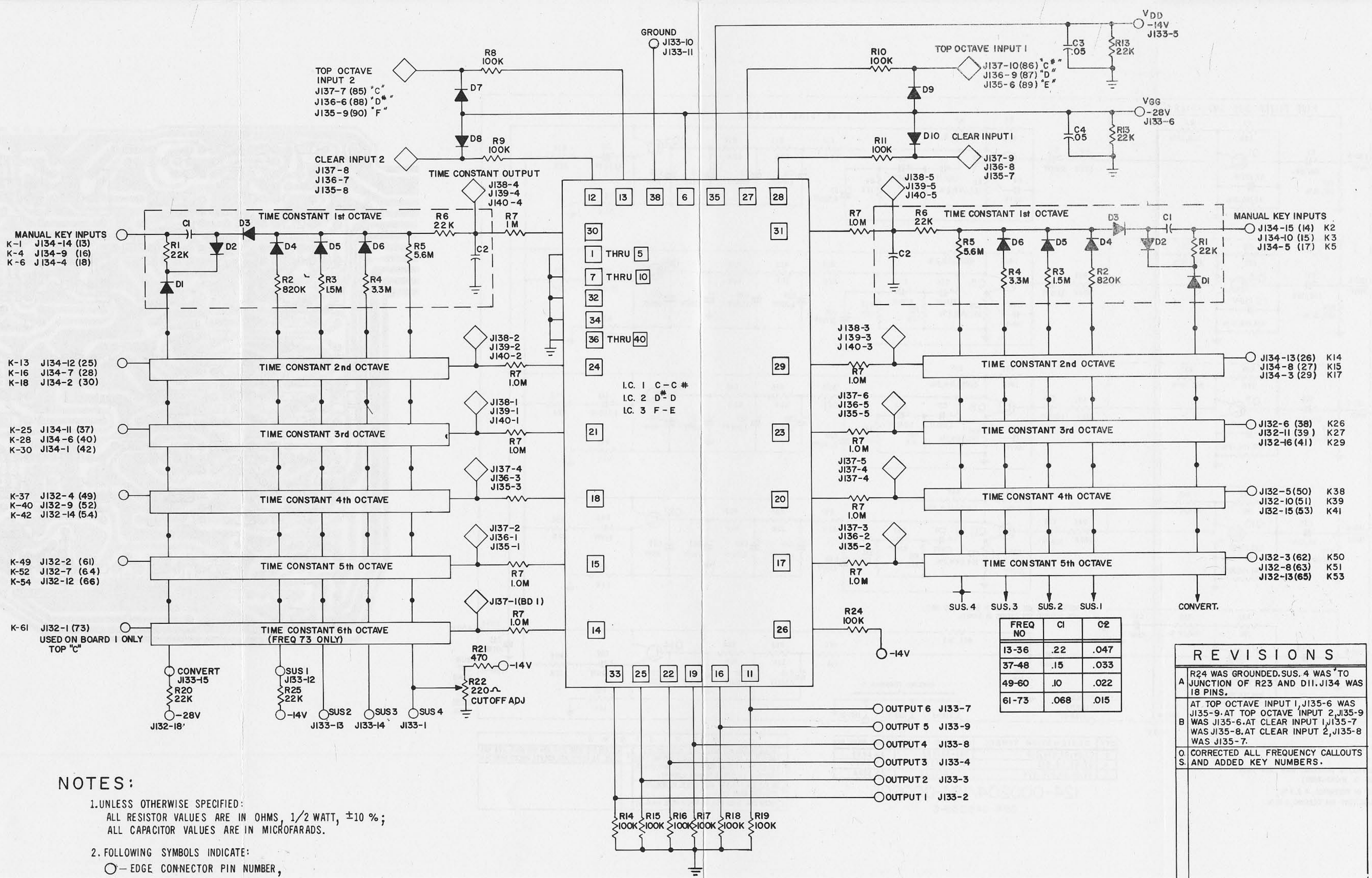


* SEE REVISION COLUMN

NOTE: FOR 124-000204 THEORY OF OPERATION SEE FIG. 3-12

⑪

FIGURE 3-14
SINE FILTER #3
SCHEMATIC, LAYOUT
AND THEORY
(124-000204)



FREQ NO	C1	C2
13-36	.22	.047
37-48	.15	.033
49-60	.10	.022
61-73	.068	.015

REVISIONS	
A	R24 WAS GROUNDED. SUS. 4 WAS TO JUNCTION OF R23 AND D11. J134 WAS 18 PINS.
B	AT TOP OCTAVE INPUT I, J135-6 WAS J135-9. AT TOP OCTAVE INPUT 2, J135-9 WAS J135-6. AT CLEAR INPUT I, J135-7 WAS J135-8. AT CLEAR INPUT 2, J135-8 WAS J135-7.
O. S.	CORRECTED ALL FREQUENCY CALLOUTS AND ADDED KEY NUMBERS.

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. FOLLOWING SYMBOLS INDICATE:
   ○ — EDGE CONNECTOR PIN NUMBER,
   □ — I.C. PIN NUMBER,
   ◇ — UPRIGHT POST CONNECTOR,
   ( ) — FREQUENCY NUMBERS IN PARENTHESIS.
   K — KEY NUMBER

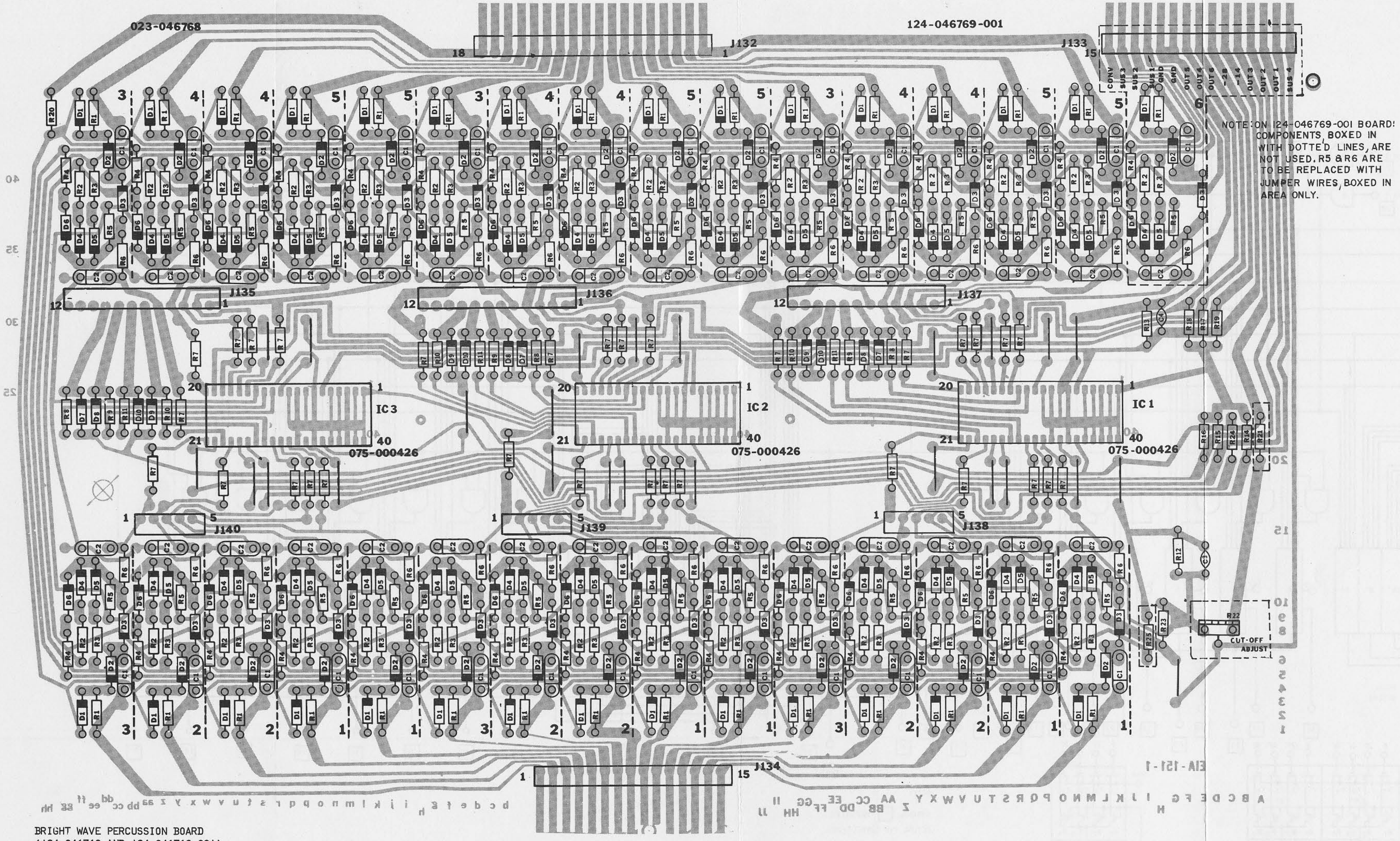
124-046769

094-045062-B

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
198	D1 THRU D10 (REPEATING)	001-026080	IN 4148
3	I.C. I, I.C. 2, I.C. 3	075-000426	

FIGURE 3-15
BRIGHT WAVE PERCUSSION
BOARD - SCHEMATIC
(124-046769)

⑫



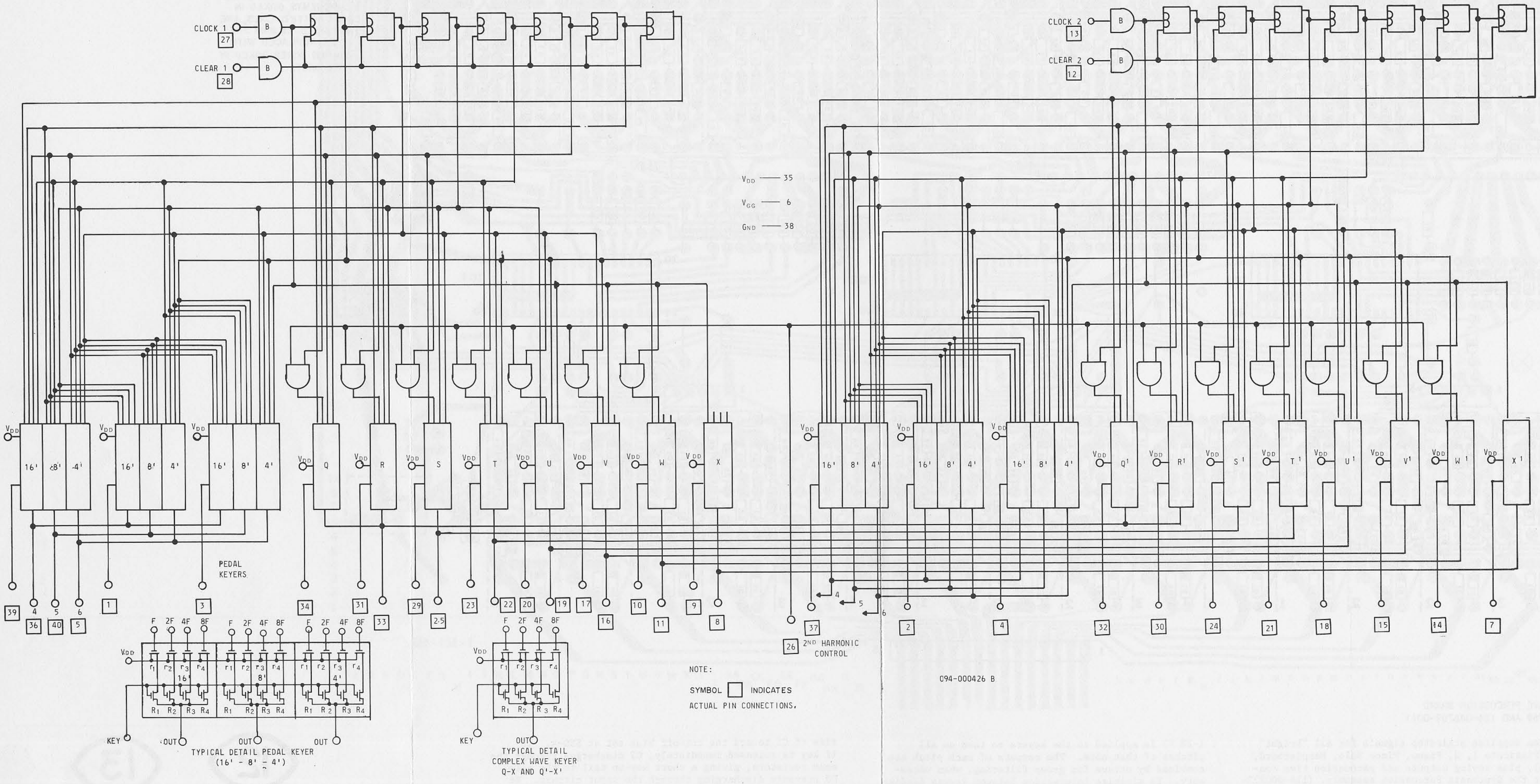
NOTE: ON 124-046769-001 BOARD: COMPONENTS BOXED IN WITH DOTTED LINES, ARE NOT USED. R5 & R6 ARE TO BE REPLACED WITH JUMPER WIRES, BOXED IN AREA ONLY.

BRIGHT WAVE PERCUSSION BOARD
(124-046769 AND 124-046769-001)

This system supplies stairstep signals for all "bright" voices, (Pizzicato 1, 2, Piano, Piano Solo, Harpischord, and Banjo), plus keying outputs and percussion time constants for the Synthesis Percussion assembly. (124-000223-001). All percussive tones except those from the rhythm units are keyed from the 426 IC assemblies. IC keyers (075-000426) combine octavely related square waves in the correct proportions to produce a stairstep configuration. Each 426 IC supplies outputs for all octaves and pitches for 2 notes on the upper manual. (For example: Five pitches of F# and G notes on the upper manual). Dividers inside the IC, divide down the Clock (Top Octave) inputs, (J-135, J-136, J-137) to the frequencies required by the keyers. A negative DC voltage (-28 V) is applied to the keyers to turn on all pitches of that note. The outputs of each pitch are combined by octave for group filtering, when necessary. To minimize interaction between keyers feeding the same filter, the input impedance of the filter is made 100 ohms or less. Consequently, the output voltage at the filter terminals (J-133,2,3,4,7,8,9) is very low when the filters are connected. To obtain a suitable envelope, a percussion time constant circuit is connected between key inputs and the IC keyers. The capacitor in series with the input (C1 on schematic 094-045062) passes an initial spike as the key switch is closed. As the switch remains closed, R2 to R5 drain off the charge on the keyer side of C1 toward the cut-off bias set at SUS-4. If If key is released, immediately, C2 discharges through the same resistors, giving a short key-up tail to the note. D3 prevents discharging through the input circuit. R6 works with C1 and C2, slowing down the attack time to minimize "key click". For repeat and alternate repeat modes, percussion keyers must be converted to straight-through keying. (See Repeat Oscillator and Detector Board 124-000260) This is accomplished when -28 V is applied to J-133-15, allowing R1 and D2 to discharge C1 quickly. To prevent cancellation effects, the 426 IC outputs are synchronized with the other Concorde keyer-generator systems. A "master" sync. signal from J-109 on the Lower Manual Synthesis Mother Board (124-000223) enters the clear inputs of the IC's (J-135-7,8/ J-136-7,8,/ J-137-8,9) causing them to act as "slaves". Keyer cut-off control R22, located on the 124-046769 board, is used to adjust the point to which the keying voltage decays during the sustain portion of the percussion mode.

⑫ ⑬

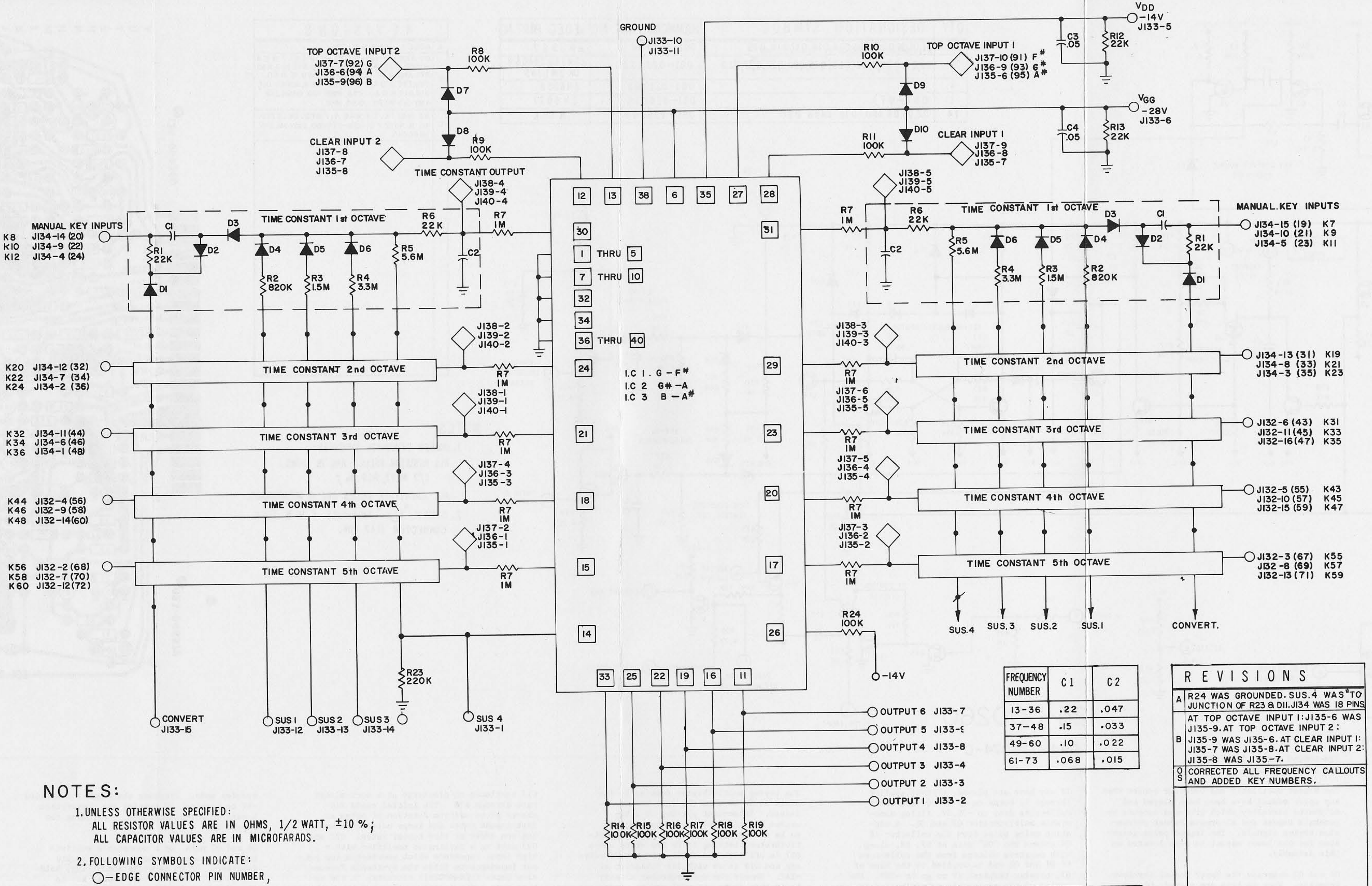
FIGURE 3-16
BRIGHT WAVE PERCUSSION
BOARD-LAYOUT AND THORY
(124-046769 and 124-046769-001)



NOTE:

SYMBOL □ INDICATES ACTUAL PIN CONNECTIONS.

FIGURE 3-17
I.C. 426, DIVIDER KEYER
PACKAGE SCHEMATIC
(075-000426)



FREQUENCY NUMBER	C1	C2
13-36	.22	.047
37-48	.15	.033
49-60	.10	.022
61-73	.068	.015

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. FOLLOWING SYMBOLS INDICATE:
   ○—EDGE CONNECTOR PIN NUMBER,
   □—I.C. PIN NUMBER,
   ◇—UPRIGHT POST CONNECTOR,
   ( )—FREQUENCY NUMBERS IN PARENTHESIS.

124-046769-001

094-045062-001-B

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
192	D1 THRU D10 (REPEATING)	001-026080	IN 4148
3	I.C.1, I.C.2, I.C.3	075-000426	—

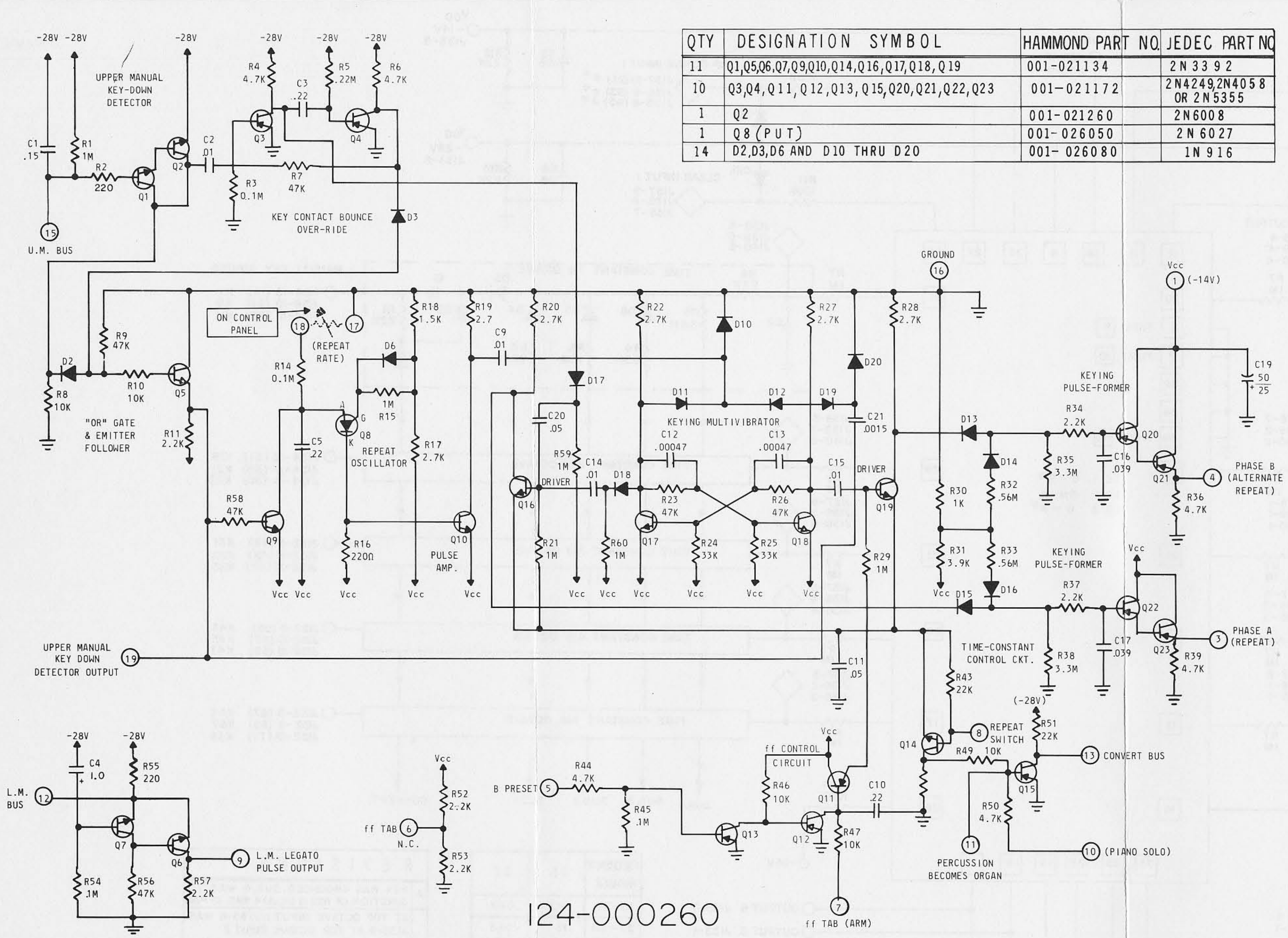
REVISIONS	
A	R24 WAS GROUNDED. SUS.4 WAS "TO" JUNCTION OF R23 & D11. J134 WAS 18 PINS
B	AT TOP OCTAVE INPUT 1: J135-6 WAS J135-9. AT TOP OCTAVE INPUT 2: J135-9 WAS J135-6. AT CLEAR INPUT 1: J135-7 WAS J135-8. AT CLEAR INPUT 2: J135-8 WAS J135-7.
OS	CORRECTED ALL FREQUENCY CALLOUTS AND ADDED KEY NUMBERS.

⑬

FIGURE 3-18
BRIGHT WAVE PERCUSSION
BOARD - SCHEMATIC
(124-046769-001)

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO
11	Q1,Q5,Q6,Q7,Q9,Q10,Q14,Q16,Q17,Q18,Q19	001-021134	2N3392
10	Q3,Q4,Q11,Q12,Q13,Q15,Q20,Q21,Q22,Q23	001-021172	2N4249,2N4058 OR 2N5355
1	Q2	001-021260	2N6008
1	Q8 (PUT)	001-026050	2N6027
14	D2,D3,D6 AND D10 THRU D20	001-026080	1N916

REVISIONS	
A	ADDED TERMINAL 19.
B	Q9 WAS 001-021172. DELETED C6,C7 & C8. ADDED C20 & C21. DELETED R12,R13,R40, R41 AND R42. ADDED R58,R59 & R60. DELETED D4,D5,D7,D8 & D9. ADDED D17, D18,D19 & D20. R55 WAS 100 OHMS. C12 AND C13 WERE .0015 MFD.
C	R2 WAS 1K, C4 WAS 4.7 MFD. DELETED D1 & NOTE:" D1=001-024050, EQUIVALENT IN4001".

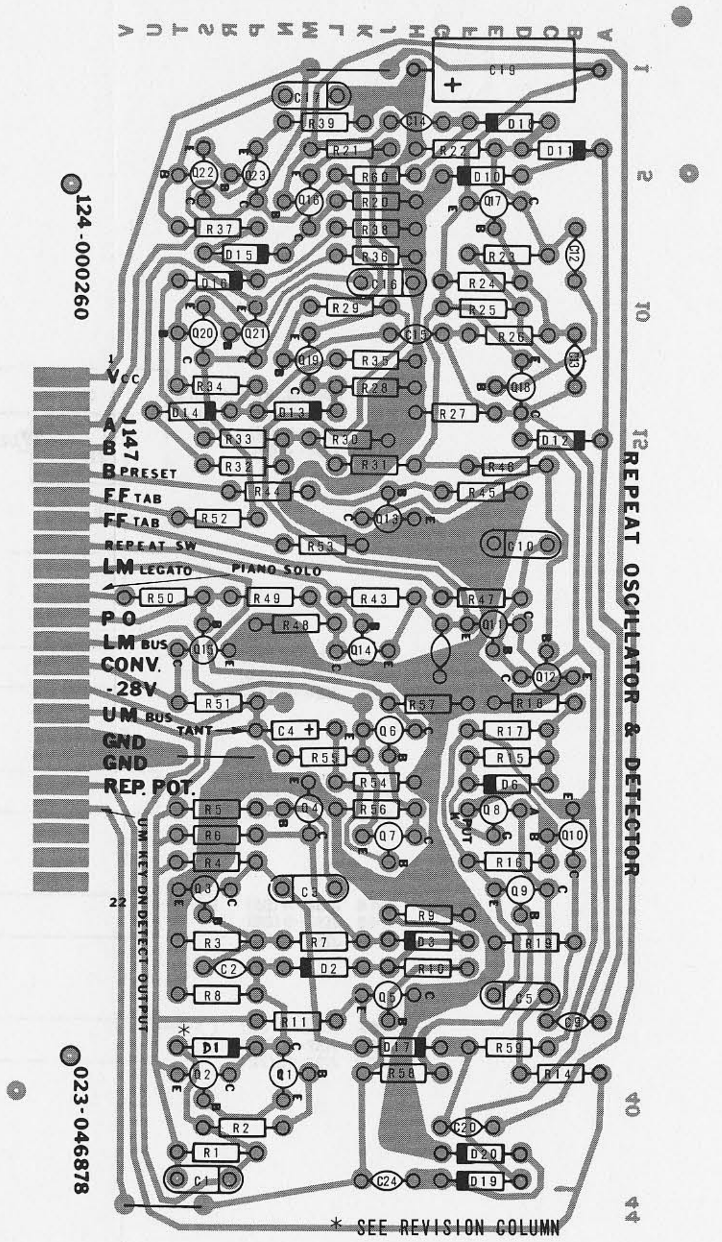


124-000260

094-046874-C

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. SYMBOL "③" SIGNIFIES P.W.B. EDGE CONNECTOR J147 PIN.



* SEE REVISION COLUMN

124-000260 REPEAT OSCILLATOR AND DETECTOR BOARD

The Repeat Oscillator and Detector senses when any upper manual keys have been played and activates circuitry which produces outputs to generate repeat and alternate repeat percussion keying signals. The legato pulse generator for the lower manual is also located on this assembly.

Q1 and Q2 comprise the Upper Manual Key-Down Detector. When no keys are played, Q1 and Q2 are biased off, terminal 15 is near -28V.

If any keys are played, current applied through R1 turns on Q1 and Q2 and their collectors drop to -26.5V, firing monostable multivibrator Q3 and Q4. A negative going pulse from the collector of Q4 enters the "OR" gate at R7, R8, along with negative voltage from the collectors of Q1 and Q2 and is applied to the base of Q5, causing terminal 19 to go to -28V. The period of the monostable multivibrator is adjusted to keep terminal 19 negative during the entire time that manual keys might exhibit "bounce".

REPEAT OSCILLATOR AND KEYERS:

When no keys are being played, Q9 is conducting, keeping C5 discharged. Upon playing any keys, Q9 is biased off, and C5 starts charging through R14 and the repeat rate potentiometer. Q8 does not conduct until C5 charges to a specific voltage, then Q8 turns on and quickly discharges C5. The resulting current flow through R15 produces a pulse which is amplified by Q10 and used to trigger keying bistable multivibrator Q17 and Q18.

The keying multivibrator remains in the state it is in when the last key is released. Subsequent playing of a key causes negative voltage at terminal 19 to be transmitted through D19 to the multivibrator, setting it to the state where Q17 is off with its collector at zero voltage and Q19 is on with its collector at -14V. Should the multivibrator already be in this state, it will remain there. After the initial pulse via D19, each succeeding pulse from Q10 will change the state of the multivibrator. Positive going voltage changes at the collector of Q17 are differentiated and applied to the base of Q16. The negative pulse output at the collector of Q16 charges the timing capacitor C17 through diode D15. If the rest state of the multivibrator is such that the collector of Q17 is positive, no pulse is present to drive Q16 when the first key is played. To insure the availability of a drive pulse, a signal is coupled from the collector of Q3 through D17 and C20 to the base of Q16. (Q3 produces a positive pulse with the first key-down). C17 starts to discharge rapidly through D16 and R33 toward a voltage level determined by voltage divider R30 and R31. As the voltage at C17 becomes more positive than the voltage set by R30 and R31, D16 cuts off and C17 continues to discharge at a much slower rate through R38. The initial rapid discharge gives uniform duration of notes at fast repeat rates and keeps notes from sounding too short at slow repeat rates. Q22 and Q23 make up a Darlington amplifier with a high input impedance which provides a low output impedance to drive the Synthesis Percussion Gates (124-000261) circuitry in the repeat mode. The positive going output at the collector of Q18 is used in a similar manner, along with Q19, Q20, and Q21 to drive the Synthesis Percussion Gates circuitry for the alternate notes in the Xylophone and Marimba voices.

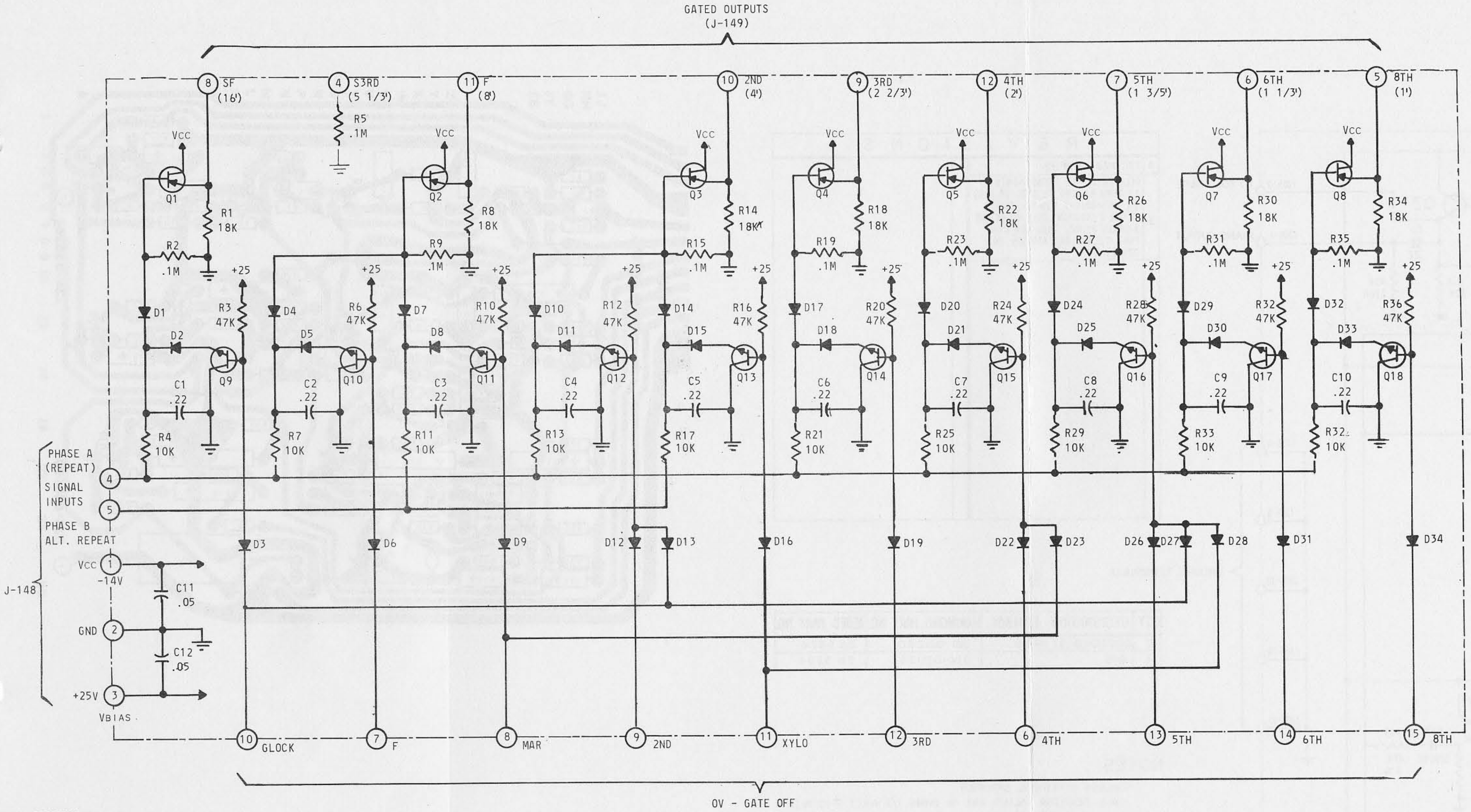
TIME CONSTANT CONTROL

When percussion system is activated, each note has its own percussion keyer. When played, notes die away even if keys are held down. When repeat is used, however, keyers must convert from percussion to normal mode so that as long as keys are down, enough signal is present for the repeat keyer to turn on and off. With the Repeat tab "ON", no connection is made to terminal 8, Q14 and Q15 are off and terminal 13 is at about -28V. This voltage applied to convertible keyers puts them in normal mode. When the Repeat tab is "off", Q14 and Q15 conduct, bringing terminal 13 near zero volts which places convertible keyers in percussion mode. Pressing the Piano tab applies -6V to terminal 10 putting the convertible keyers in percussion mode, overriding the Repeat tab.

Q6 and Q7 make up a monostable multivibrator for use as a lower manual legato detector. Q7 is normally conducting, holding Q6 off. When a lower manual key is played, the voltage across R55 triggers the circuit causing Q6 to generate a negative pulse at terminal 9. This action repeats for each additional key until 15 or 20 are played.

14

FIGURE 3-19
REPEAT OSCILLATOR AND
DETECTOR BOARD, SCHEMATIC
LAYOUT AND THEORY
(124-000260)



NOTES:

1. IF OTHERWISE NOT SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
ALL CAPACITOR VALUES ARE IN MICROFARADS.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
8	Q1 THRU Q8	001-021172	2N 4249
10	Q9 THRU Q18	001-021134	2N 3394
34	D1 THRU D34	001-026080	1N 4148

124-000261

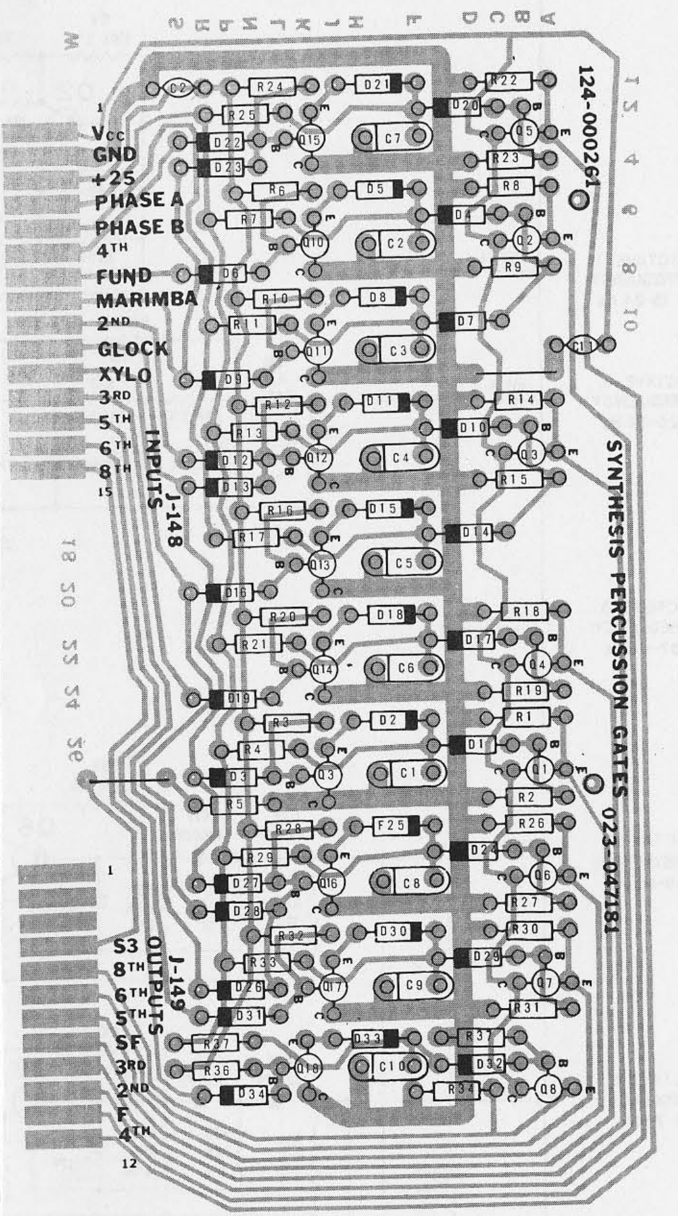
094-046879-0

R E V I S I O N S

SYNTHESIS PERCUSSION GATE BOARD (124-000261)

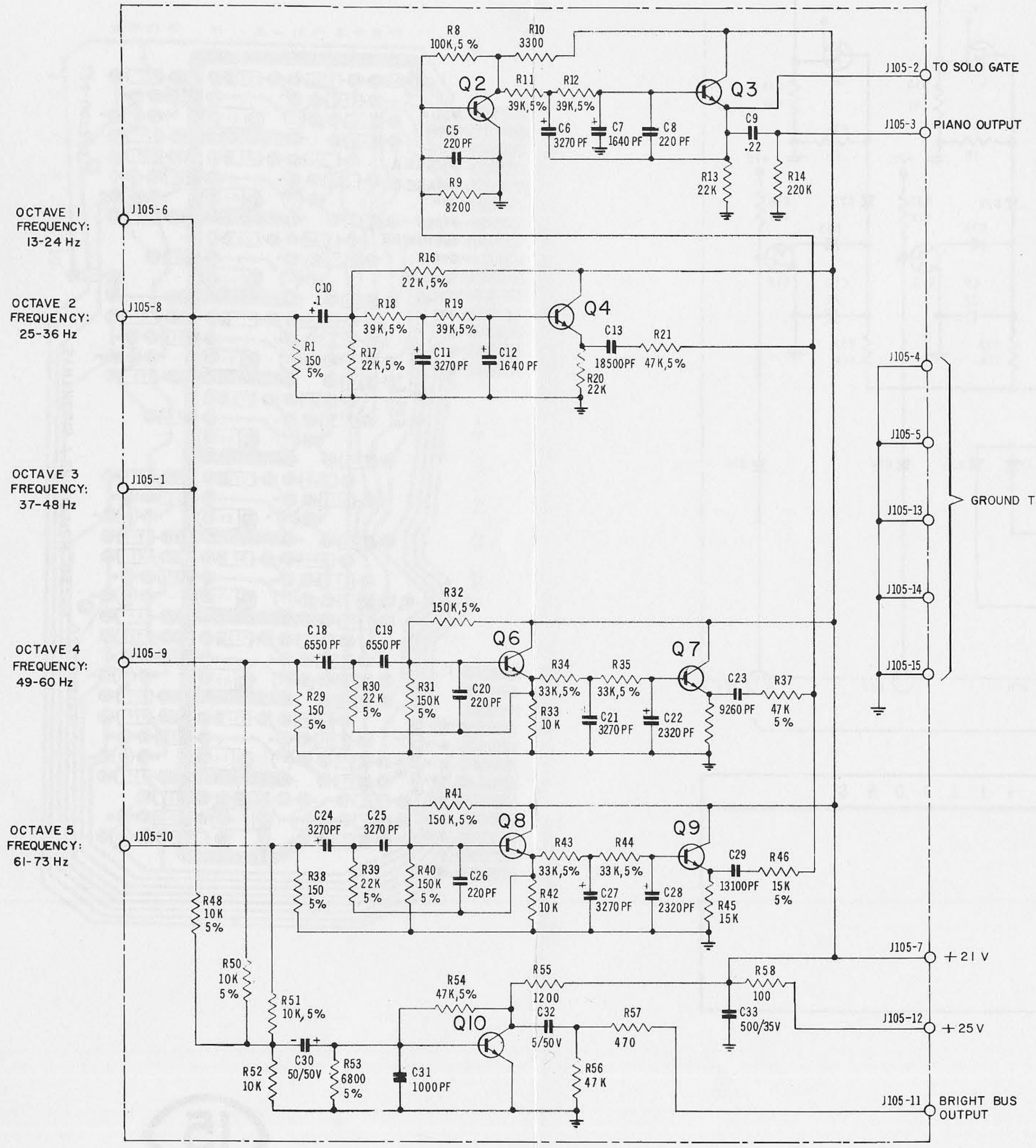
An assembly used for controlling negative going pulse wave-forms between the Repeat Oscillator and Detector board, (124-000223-001) in repeat and alternate repeat modes. In normal keying mode, +25 V is applied to the base terminals of Q9-Q18, placing them in a saturated state and shorting input to ground. When a percussion tab is depressed, -14 V is impressed on terminals J-148-6, 7, 8, 9, 11, 12, 13, 14, and 15, placing Q9-Q18 in a non-conducting state, opening gates and shunting input signals through to appropriate outpt terminals.

Phase A alone admits repeat signal only, at J-148-4. Phase A, plus Phase B, adds alternate repeat signal at J-148-5, for twin-mallet effect on Xylophone and Marimba Voices.



⑮

FIGURE 3-20
SYNTHESIS PERCUSSION
GATE BOARD, SCHEMATIC,
LAYOUT AND THEORY
(124-000261)



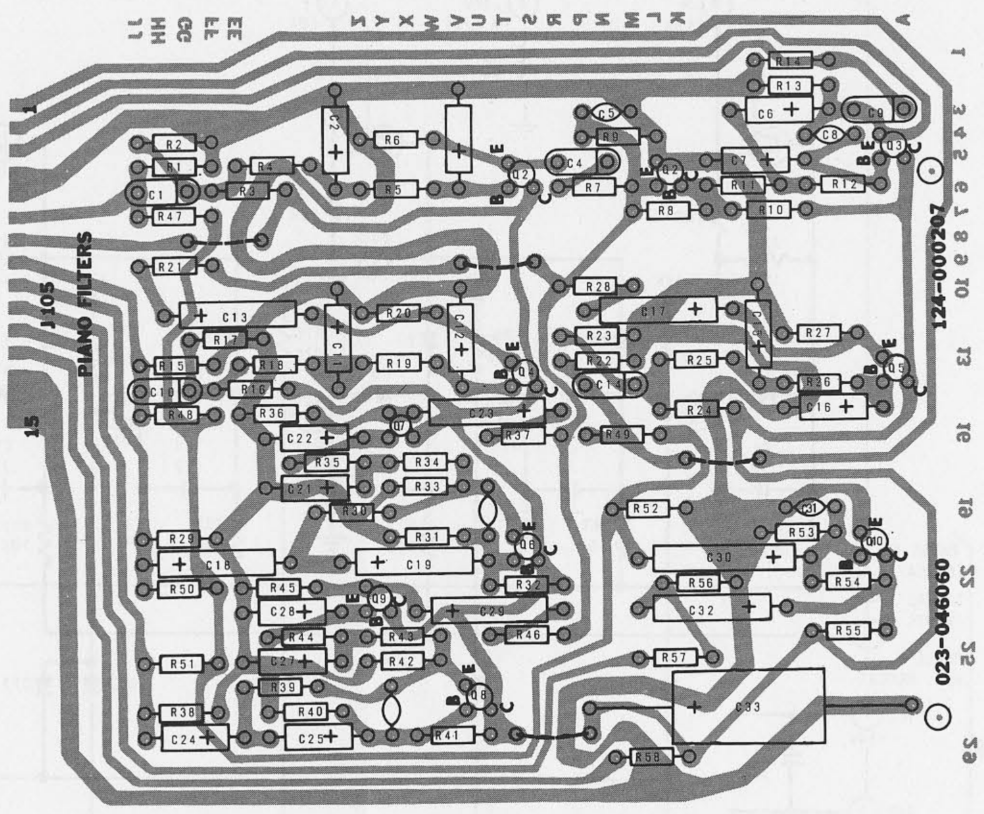
REVISIONS			
A	C30 WAS 25 VOLTS.		
B	DELETED OCTAVE 1 COMPONENTS: R2 THRU R7 AND C1 THRU C4, ALSO Q1-001-021135. R15 DELETED IN OCTAVE 2 CIRCUITRY. DELETED OCTAVE 3 CIRCUITRY: R22 THRU R28, C14 THRU C17, R47, R49 AND Q5-001-021135.		

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
7	Q2,Q3,Q4,Q6,Q7,Q8,Q9	001-021260	2N 5826
1	Q10	001-021133	2N 3394

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

124-000207
094-046069-B



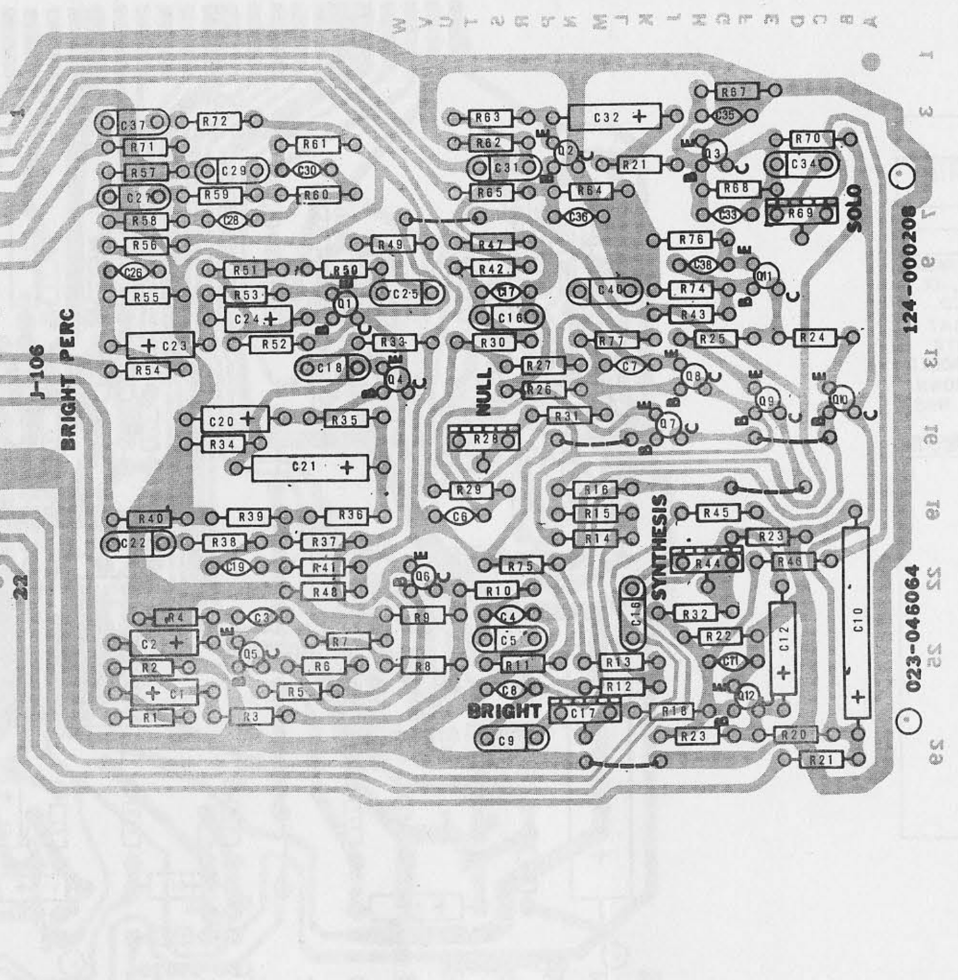
124-000207 PIANO FILTER BOARD

At J105, on the assembly, three filter groups are fed by a five octave input with the three lowest octaves tied together and applied to a single filter section. IC keyers develop a signal of 150-200 mv P/P at the 150 ohm input load resistors. Active low pass 2 pole filter sections are used with an extra high pass filter stage in the two highest octaves providing a sharp low frequency cutoff slope to reduce keying thump to an acceptable level. The lowest octave uses input and output coupling capacitors to control low frequency cutoff. The three filter groups are mixed into summing amplifier Q2 and passed through another active low pass 2 pole filter section, where Q3 provides a low impedance output for the Piano Solo input on the Bright Percussion Filter Board assembly. (124-000208)

Another function of the Piano Filter Board is, supplying an output for the low impedance filters on the Bright Percussion Filter PWB (Pizzicato 1, 2, Piano, Harpsichord, Banjo). The five octave stair-step wave frequencies are resistively mixed into bright summing amp Q10, (bypassing the piano filters) which provides a low impedance output at Pin 11. A resistor in series with the output supplies automatic robbing so that one voice can be loud enough without having several voices at an unreasonable level simultaneously.

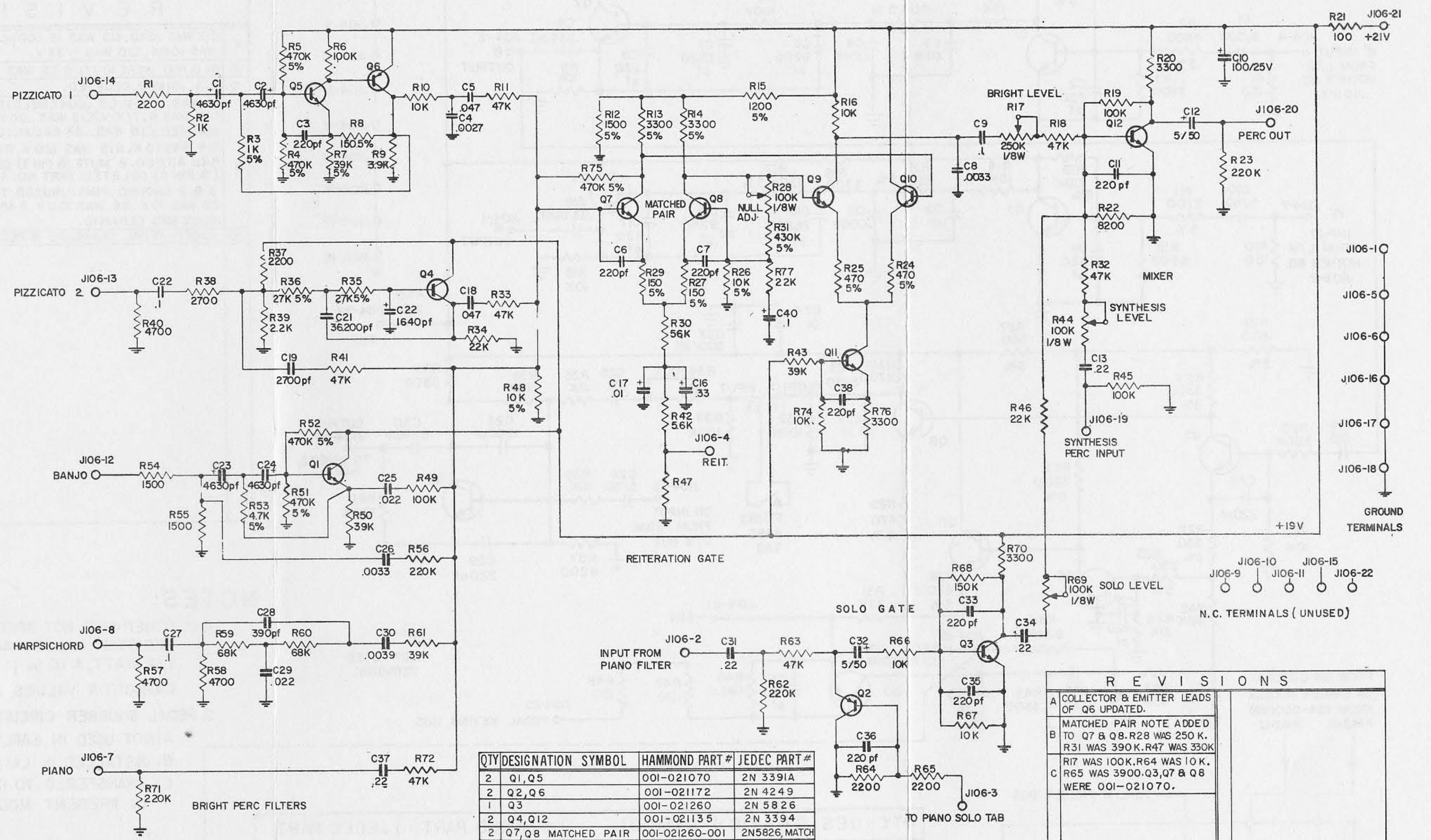
NOTE: EARLIER VERSIONS OF THE 124-000207 BOARD CONTAINED FIVE FILTER GROUPS FOR THE INPUTS INSTEAD OF THREE, BUT WERE SIMILAR TO THE CURRENT DESIGN IN ALL OTHER ASPECTS.

FIGURE 3-21
PIANO FILTER BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000207)



124-000208 BRIGHT PERCUSSION FILTER BOARD

Signals enter the board at J106 and pass thru three active filters; Pizzicato 1, 2 and Banjo, a passive filter is used for Harpsichord. The filter outputs are mixed with a Piano voice input from the 124-000207 board into the repeat gate composed of Q7, Q8, Q9 and Q10, a two stage differential amplifier that has the emitter current of its first stage (Q7-Q8) supplied by a sawtooth repeat signal from J147 on the Repeat Oscillator and Detector board (124-000260) when repeat is on, or a D.C. level when repeat is off. There is a null adjustment (R28) to minimize repeat thump, requiring a matched pair of transistors (001-021260-001) in the first stage to achieve the best null. Tab action changes the level of D.C. or sawtooth signal to the repeat gate, providing Fortissimo as desired. When Piano Solo is used, repeat signal and control voltage are removed, turning off Bright Percussion. On/Off gating at Q2 and amplification at Q3 are provided for Piano Solo whose input at pin 2 bypasses the repeat gate. Synthesis percussion signals enter this board at pin 19 and are summed with repeated bright percussion and Piano Solo at output amplifier, Q12.



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10%;
   CAPACITOR VALUES ARE IN MICROFARADS,
   WITH VOLTAGES SHOWN FOR ELECTROLYTICS ONLY.
   CAPACITOR TOLERANCE - MYLAR & CERAMIC: ±10 %, POLYSTYRENE: ±2.5 %.

QTY	DESIGNATION SYMBOL	HAMMOND PART #	JEDEC PART #
2	Q1, Q5	001-021070	2N 3391A
2	Q2, Q6	001-021172	2N 4249
1	Q3	001-021260	2N 5826
2	Q4, Q12	001-021135	2N 3394
2	Q7, Q8 MATCHED PAIR	001-021260-001	2N5826, MATCH
2	Q9, Q10	001-021133	2N 3394
1	Q11	001-021132	2N 3394

124-000208
094-046070-C

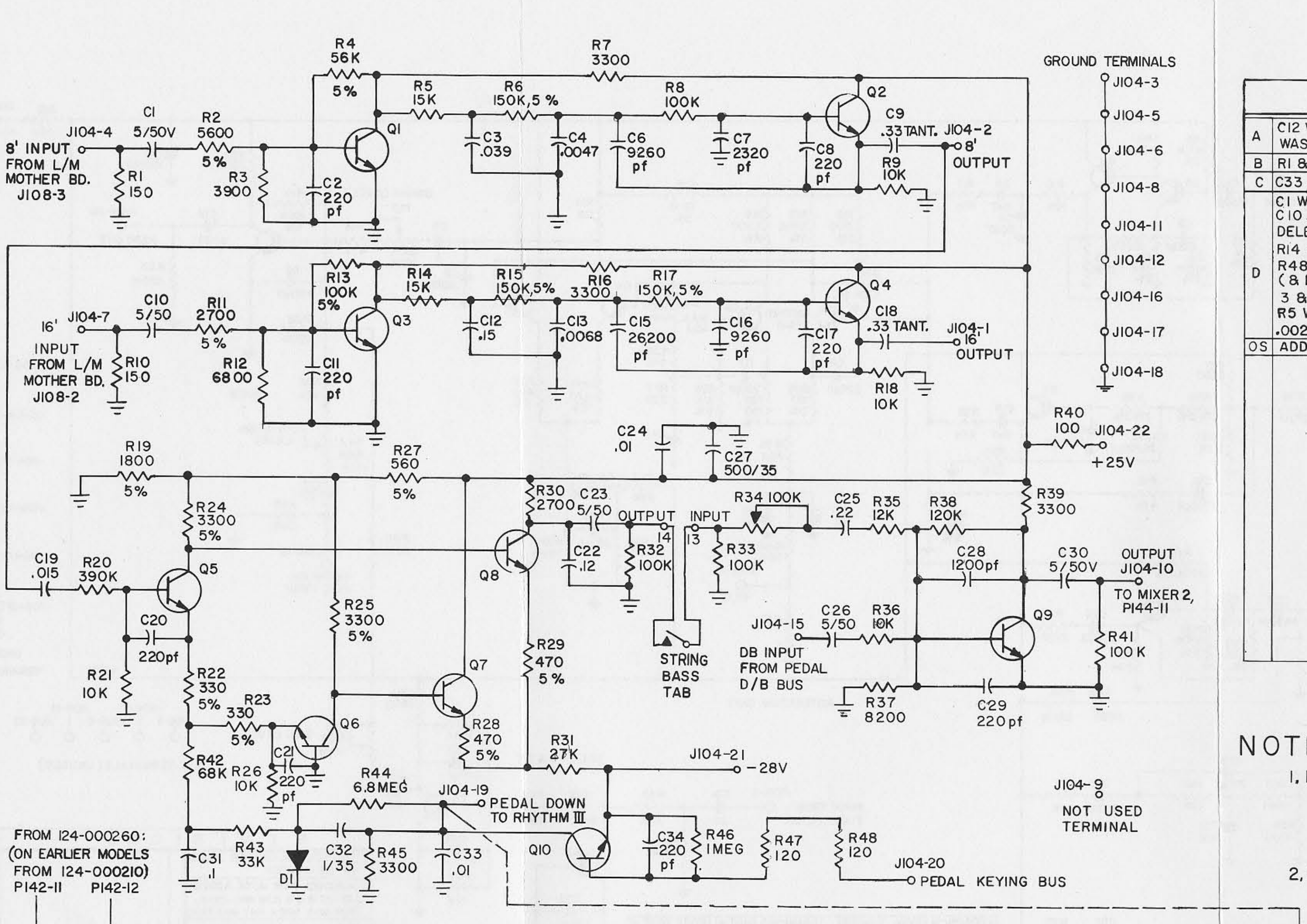
REVISIONS			
A	COLLECTOR & EMITTER LEADS OF Q6 UPDATED.		
B	MATCHED PAIR NOTE ADDED TO Q7 & Q8. R28 WAS 250 K. R31 WAS 390 K. R47 WAS 330K		
C	R17 WAS 100K. R64 WAS 10 K. R65 WAS 3900. Q3, Q7 & Q8 WERE 001-021070.		

Gain controls are provided for these signals at R69 (Solo), R44 (Synthesis), and R17 (Bright). The required +21V comes from the Piano Filter Board (124-000207) which has a decoupling filter for the supply.

NOTE: Earlier versions of the 124-000208 Bright Percussion board have matched 001-21270's in the repeat gate. (Q7 and Q8).

⑰

FIGURE 3-22
BRIGHT PERCUSSION FILTER
BOARD-SCHEMATIC, LAYOUT
AND THEORY
(124-000208)



124-000206

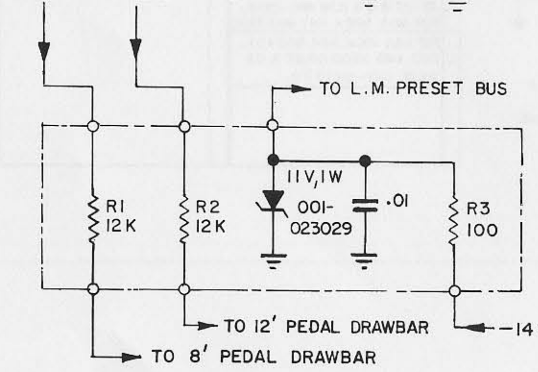
094-046068-D

REVISIONS	
A	C12 WAS .082. C15 WAS 18,500 pf. C18 WAS .22. R15 WAS 100K. C10 WAS 1/35 V.
B	R1 & R10 WERE 100Ω. R35 WAS 15 K.
C	C33, .01MFD, DELETED.
D	C1 WAS 1/35 V. C5, .0047, DELETED. C9 WAS .47 RADIAL. C10 WAS 4.7/10 V. C13 WAS .0047 CERAMIC. C14, .01, DELETED. C18 WAS .33 RADIAL. C33, .01, DELETED. R14 WAS 10 K. R15 WAS 120 K. R17 WAS 100 K. R47 & R48 ADDED. 8' MUTE (& PIN 3) DELETED. 16' MUTE (& PIN 8) DELETED. PART NO. ADDED TO Q9. ADDED 3 & 8 GROUND PINS. UNUSED TERMINAL 9 SHOWN. R5 WAS 10 K. R6 WAS 150 K. R45 WAS 15 K. C4 WAS .0022 MFD. CERAMIC.
OS	ADDED PEDAL DRAWBARS & PEDAL SNUBBER CIRCUITS.

NOTES:

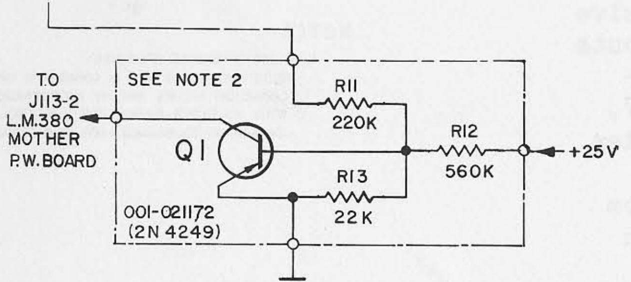
1. IF OTHERWISE NOT SPECIFIED:
   RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ± 10 %;
   CAPACITOR VALUES ARE IN MICROFARADS.
2. PEDAL SNUBBER CIRCUIT:
   - * A) NOT USED IN EARLY MODELS.
   - B) INSTALLED IN LATER MODELS, AS SHOWN.
   - C) TRANSFERED TO 124-000360 P.W. BOARD IN PRESENT MODELS.

QTY	DESIGNATION SYMBOL	HAMMOND PART	JEDEC PART
5	Q1,Q2,Q3,Q4,Q9	001-021135	2N 3394
2	Q5,Q6	001-021070	2N 3391A
2	Q7,Q8	001-021133	2N 3394
1	Q10	001-021260	2N 5826
1	D1	001-026080	IN 4148



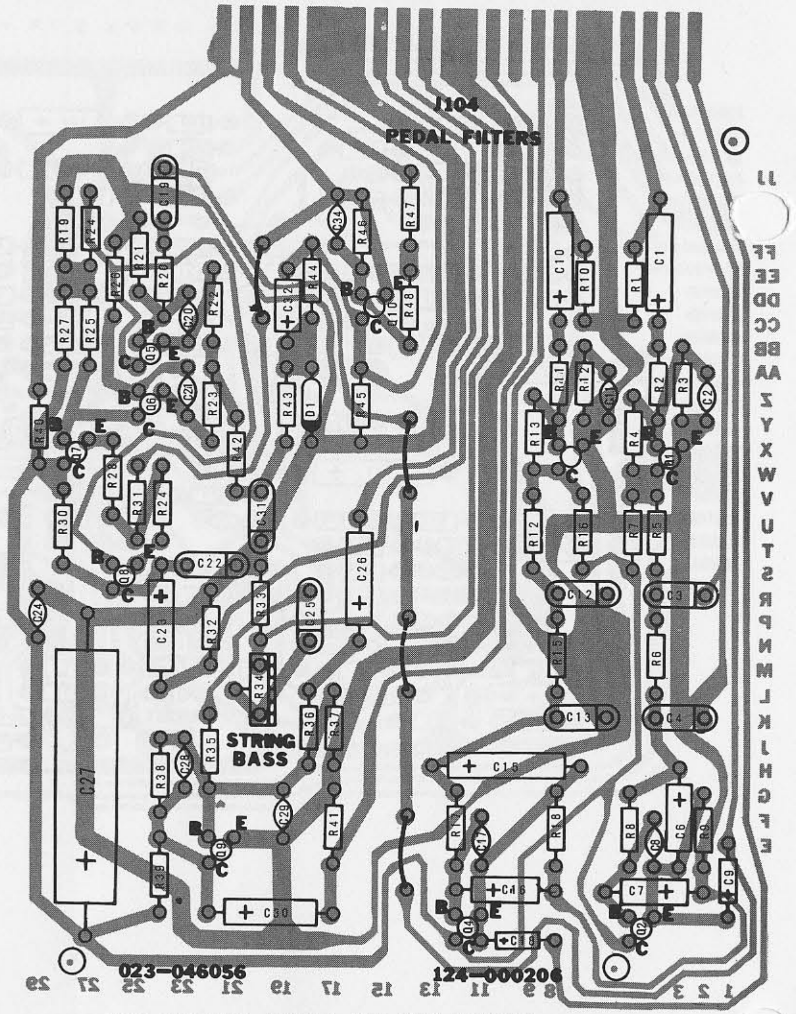
PEDAL DRAWBARS TERMINAL STRIP

063-046759



PEDAL SNUBBER TERMINAL STRIP

063-048130



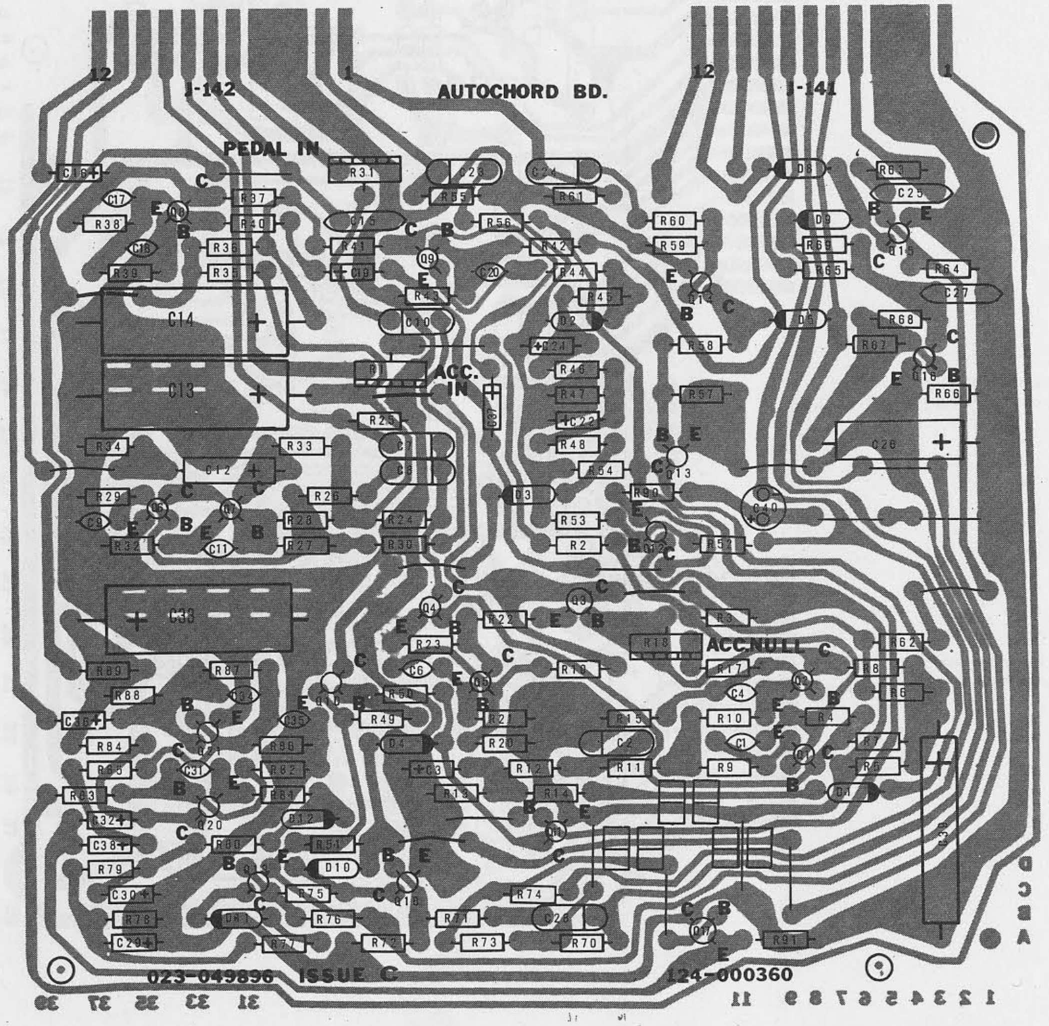
124-000206 PEDAL FILTER BOARD

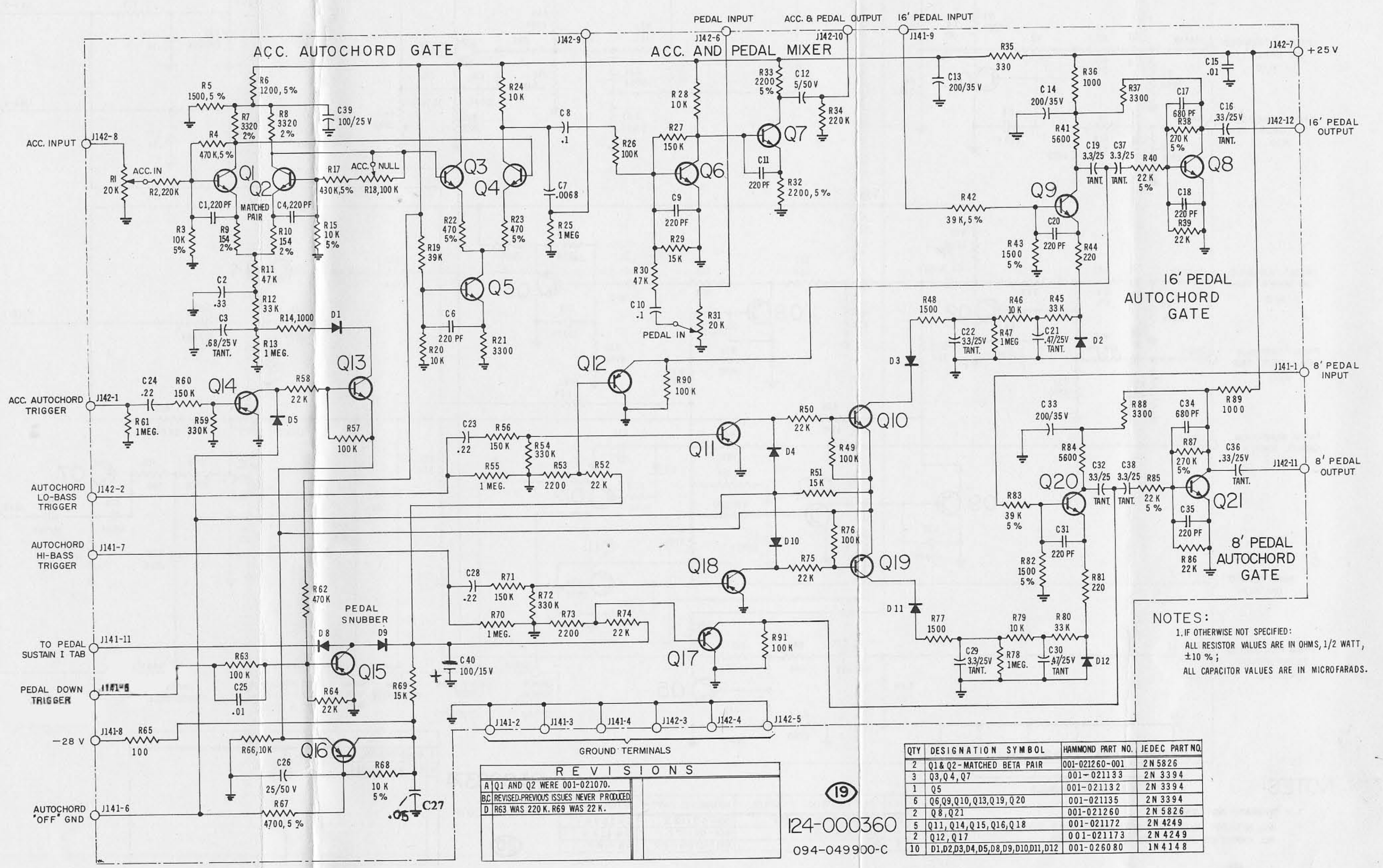
Pedal output signals (Square-Wave) from J111 and J112 on the Lower Manual Synthesis Mother Board, (124-000223) enter the 16' and 8' active low pass filter circuits at J104, pins 7 and 4, of the Pedal Filter Board where sine-wave pedal tones are produced. 8' String Bass gating and a pedal down detector are also provided. The String Bass gate is a two stage differential amplifier, (Q5-Q6 and Q7-Q8) which operates in a touch response percussion mode, but does not decay to inaudibility. Touch response keying information for the String Bass circuit and follow-the-player rhythm is provided by the pedal down detector, which connects to the pedal keying bus. R47 and R48 prevent Q10 in pedal down detector from failing when pedal keying bus is shorted to ground. Pedal tones go to associated terminal strip and to either J141, pins 1 and 9 on the auto-accompaniment board (124-000360) or to pedal tonebars thru external 12K resistors, then back to Q9 on pedal filter board for amplification and mixing with String Bass.

CAUTION NOTE: Early models of the 124-000206 board do not have protective resistors, therefore pedal keying bus must not be shorted to ground.

18

FIGURE 3-23
PEDAL FILTER BOARD AND
SNUBBER TERMINAL STRIP
SCHEMATIC, LAYOUT AND THEORY
(124-000206)





NOTES:

1. IF OTHERWISE NOT SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
ALL CAPACITOR VALUES ARE IN MICROFARADS.

REVISIONS	
A	Q1 AND Q2 WERE 001-021070.
B,C	REVISED. PREVIOUS ISSUES NEVER PRODUCED.
D	R63 WAS 220 K. R69 WAS 22 K.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
2	Q1 & Q2 - MATCHED BETA PAIR	001-021260-001	2N 5826
3	Q3, Q4, Q7	001-021133	2N 3394
1	Q5	001-021132	2N 3394
6	Q6, Q9, Q10, Q13, Q19, Q20	001-021135	2N 3394
2	Q8, Q21	001-021260	2N 5826
5	Q11, Q14, Q15, Q16, Q18	001-021172	2N 4249
2	Q12, Q17	001-021173	2N 4249
10	D1, D2, D3, D4, D5, D8, D9, D10, D11, D12	001-026080	1N 4148

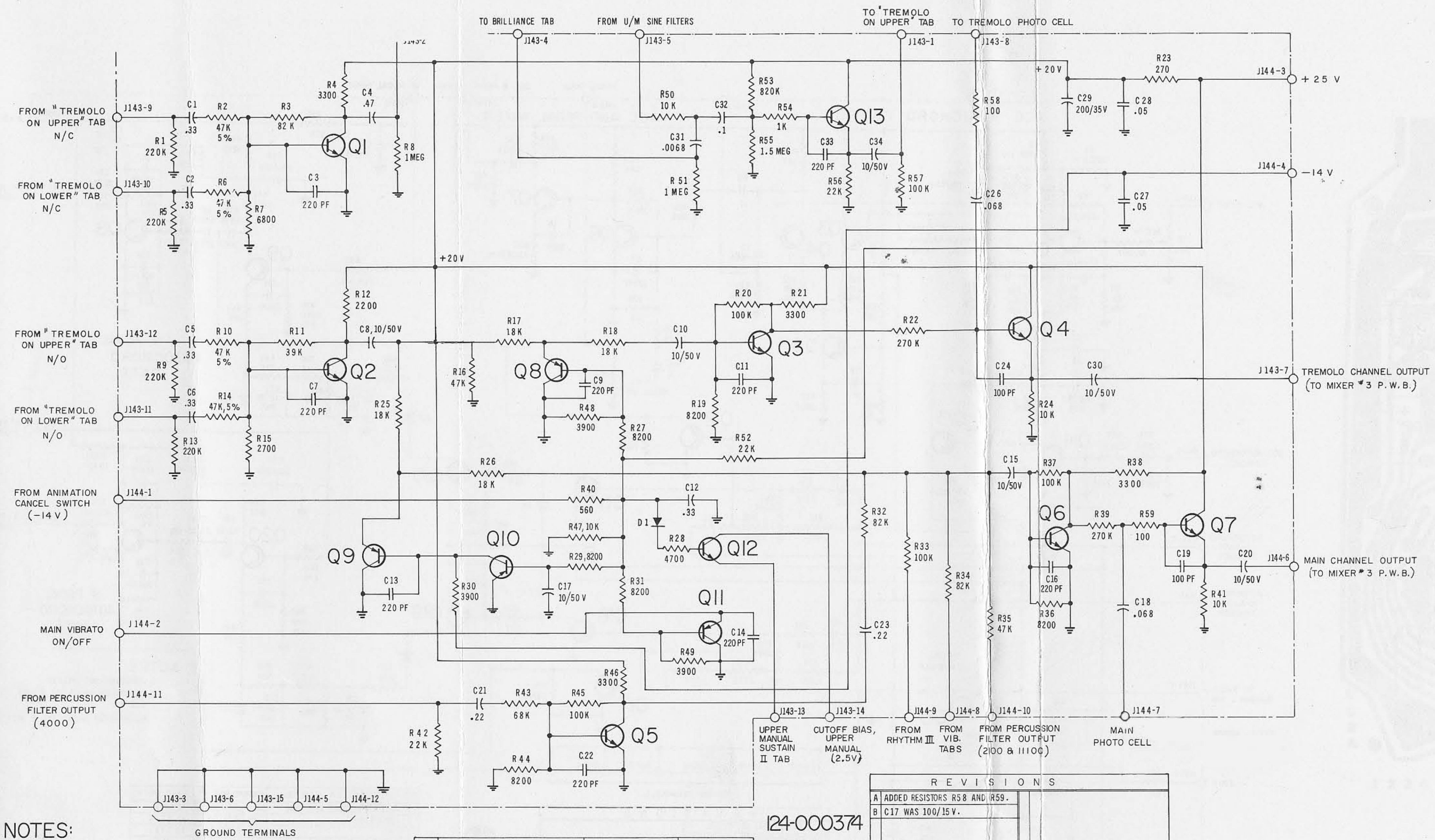
124-000360 AUTO-ACCOMPANIMENT BOARD

Triggered by pulses from the Timing Generator Board, (124-000214) this assembly provides gating for lower manual and pedal voices when automatic accompaniment and chording is desired. The lower manual gate has a fixed time constant provided by a two stage differential amplifier with the emitter current of the first stage supplied by pulses from the rhythm unit when "on" and turns off when supplied with a D.C. level. A brilliance control is provided at the output which grounds J-142-9 to roll off response 3 DB at 2000 HZ when "off". In the "on" position, ground is removed, making high frequencies apparent. Gain is unity with no phase inversion and a null adjustment is provided to reduce thump.
Pedal gates are single transistor keyers and pedal down audio gating is used to prevent thump when no signal is present. A pedal snubber circuit is provided to allow channelling of pedal and lower manual signals into the tremolo unit. Pedal gain is controlled by potentiometer R31.

NOTE: On early models of the Concorde, the Auto-accompaniment functions are carried out on the Mixer #1 board, (124-000210) which is similar to the current assembly but has an additional differential gate and null adjustment (for the pedals) and uses diodes to kill sustain on lower manual and pedals. Pedal snubber circuit and pedal gain pot are not provided on this board.

⑲

FIGURE 3-24
AUTO CHORD BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000360)



NOTES:

1. IF OTHERWISE NOT SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10 %;
ALL CAPACITOR VALUES ARE IN MICROFARADS.

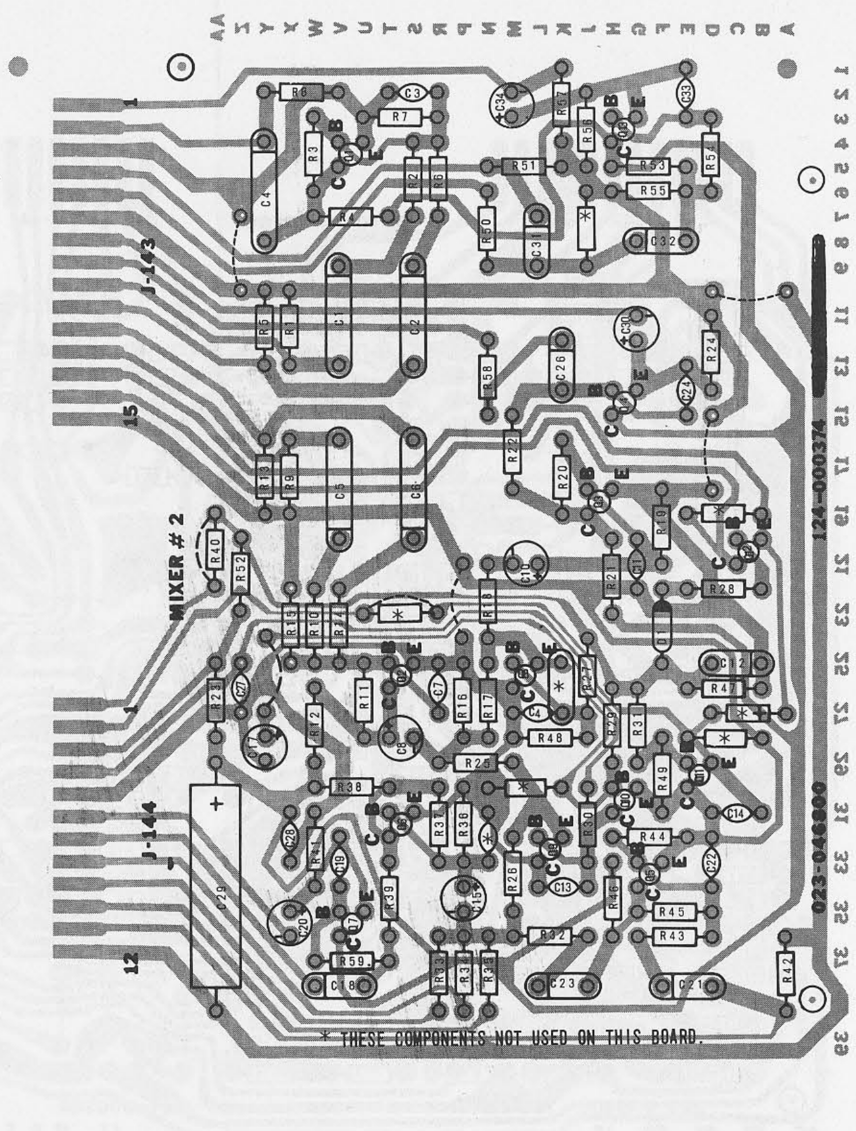
QTY	DESIGNATION SYMBOL	HAMMOND PART #	JEDEC PART #
9	Q1 THRU Q7 & Q12, Q13	001-021135	2N3394
4	Q8, Q9, Q10, Q11	001-021172	2N4249
1	D1	001-026080	1N4148

124-000374

094-050409-B

⑳

REVISIONS	
A	ADDED RESISTORS R58 AND R59.
B	C17 WAS 100/15 V.



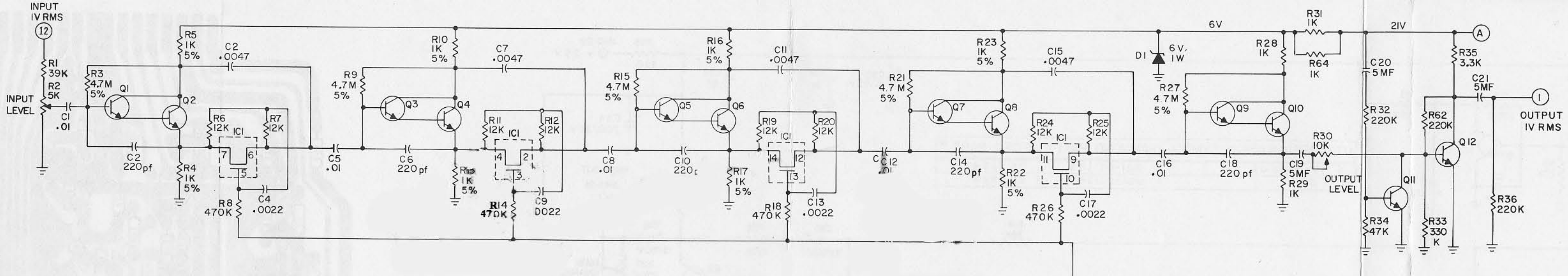
124-000374 MIXER #2 BOARD

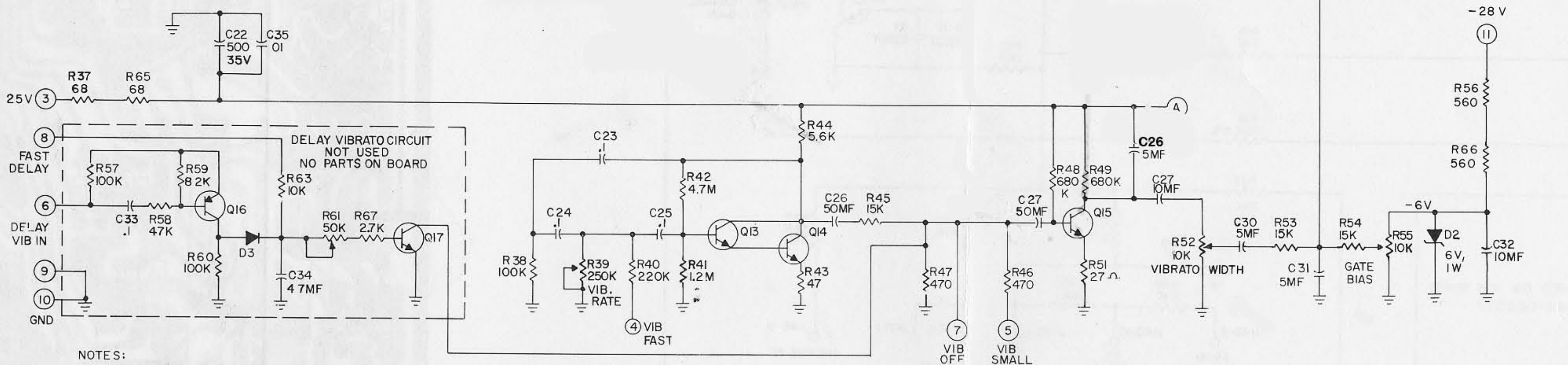
This assembly is used to provide animation cancel circuitry, swell pedal contouring for main and tremolo channels, mixing of upper and lower manual signals into After Vibrato or Acoustic Tremolo and mixing of After Vibrato output, percussion, rhythm low frequencies and pedal signals into the main channel. A brilliance control is included for the upper manual. When brilliance control is on, a ground is removed from the circuit allowing upper manual response to be flat. Turning off the brilliance control connects circuit to ground and response rolls off 3 DB/octave from 2000 HZ. The control has a built-in 2 DB loss, which enables the lower manual brilliance control on the Auto-Accompaniment Board (124-000360) to be effective. The animation cancel circuitry is an electronic single pole, double throw switch with "pop" suppression, activated by -28V applied thru the expression pedal left side switch. Closing the switch removes all signals in the tremolo channel and routes them to the main channel. In parallel with the "Sustain to Foot Switch" tab, an electronic switch opens the upper manual 380 time constant circuit, converting the keyers to long sustain mode. Another switch grounds the After Vibrato On/Off control line, removing vibrato.

NOTE: Previous Concorde models came with a 124-000211 Mixer #2 Board, a device similar to the current design, but without "pop" suppression and incorporating a pedal control pot which is now on the Auto-Accompaniment assembly. (124-000360).

⑳

FIGURE 3-25
MIXER BOARD #2
SCHEMATIC, LAYOUT AND THEORY
(124-000374)





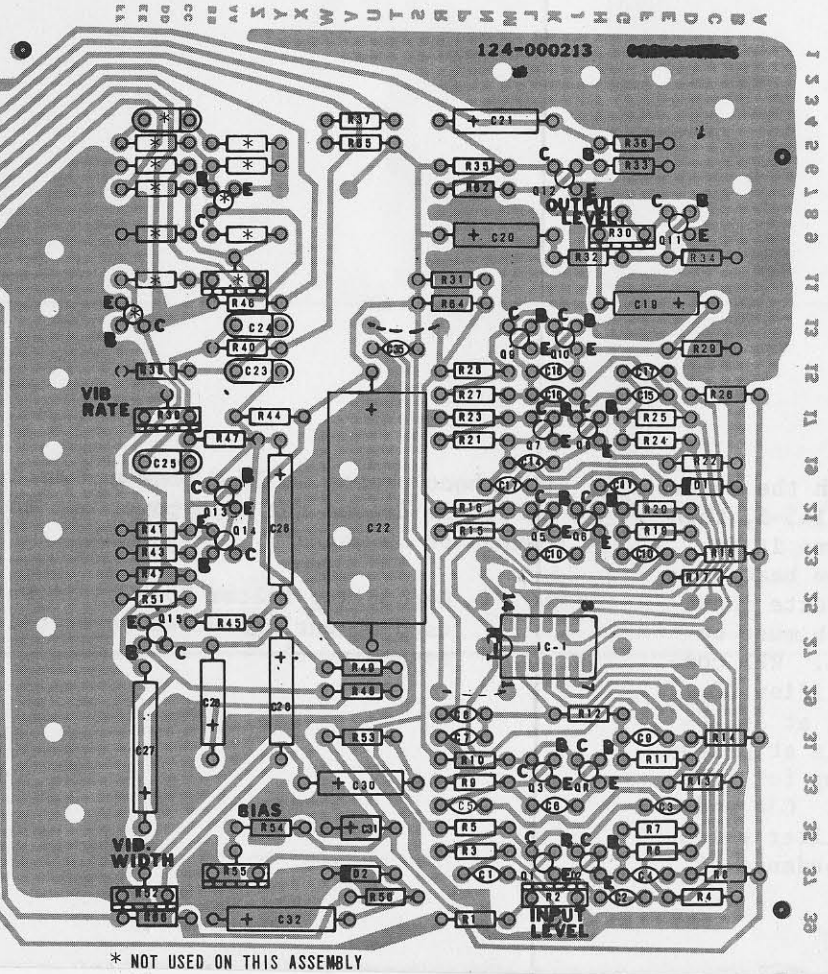
R E V I S I O N S	
A	001-023033 TRANSISTORS WERE 001-23033.
B	ADDED NOTES 1 AND 2.
C	TERMINAL NOS. WERE FROM 1 TO 10.
D	Q1 THRU Q8 AND Q12 WERE 001-021135.

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS ± 10% 1/2 WATT;
ALL CAPACITORS ARE IN MICROFARADS.
2. CIRCLED NUMBERS REFER TO TERMINALS ON PRINTED WIRING BOARD.
3. IC1 IS 4 MATCHED P CHANNEL FET.

QTY	DESIGNATION SYMBOL	HAMMOND PART NUMBER	JEDEC PART NUMBER
11	Q1 THRU Q10 AND Q12	001-021260	2N 5826
5	Q11, Q13, Q14, Q15, Q17	001-021133	2N 3394
1	Q16	001-021170	2N 4249
2	D1, D2	001-023033	1N 1766
1	D3	001-026030	1N 461A

124-000213

094-046349-D



* NOT USED ON THIS ASSEMBLY

124-000213 AFTER VIBRATO BOARD

Two After Vibrato Printed Wiring Boards are used, one each for the main and reverb channels, as they are similar in function, only the main channel system will be described. The desired vibrato rate is 4.8 to 6.8 HZ.

These are the sub-circuits included in each After Vibrato System:

1. Vibrato rate oscillator with on, off, rate and amplitude controls.
2. Adjustable regulated bias supply and regulated reference supply voltages.
3. Four cascaded, variable phase shift circuits.
4. Output amplifier.
5. Output time delay.

From Q1 of the vibrato mixer, (on Mixer #2 Board, 124-000374) signals enter a potentiometer voltage divider, (J151) providing a maximum level at the emitter of the first phase splitter of .35V R.M.S. The Darlington phase splitter develops signals 180° out of phase at the collector and emitter of Q2. The signals are combined in the following networks of the collector capacitor, C3 and the FET, a section of IC-1, which is used as a variable resistor. The source-to-drain resistance of the FET is controlled by a DC voltage appearing between the source and gate terminals. When the gate is slightly negative to the source, the drain-to source resistance is low. (100-600 ohms). As the gate is made more negative to the source, the drain-to-source resistance rapidly increases to many meg ohms. This high resistance is limited to 24K ohms by R6 and R7 in series across source and drain of the FET. By applying DC bias to the gate and super imposing a vibrato rate sine-wave on the bias, the source-to-drain path appears as a pure resistance, varying a pre-determined rate from 100 to 24K ohms, in a sine-wave configuration. Feedback at the FET gate is supplied from the junction of R6 and R7 through C4 to cancel phase distortion of the FET. The signal at the junction of C3 and the drain of the FET varies in phase, due to the reactance of the capacitor, in conjunction with the varying resistance of the FET.

HOW PHASE SHIFT OCCURS: Assuming the two extremes of FET resistance to be zero ohms and infinity, at the zero point the collector signal is attenuated by the reactance of capacitor C3, so the signal appearing at the junction of C3 and the FET has the phase of the emitter signal. When the FET goes to open circuit or infinite resistance, the C3-FET junction is connected only to the collector signal, phase 180° away from the emitter signal. Since reactance is a function of frequency, a frequency occurs where capacitor C3 reactance equals FET resistance. At this point, the phase appearing at the C3-FET junction is 90° away from both collector and emitter. As the FET resistance varies smoothly between its limits, the phase of signals appearing at the junction varies smoothly between the limits determined by capacitor reactance and signal frequency. Since an instantaneous change in phase is equivalent to a change in frequency, a vibrato effect is obtained when phase is changed at vibrato rate in a sine-wave manner. A single stage does not provide sufficient phase shift for the required vibrato effect, so four stages have been cascaded. The fourth stage is amplified to provide standard level (1V) and impedance. The single transistor joining the base of the final output transistor to ground is a delay switch to hold output cut-off until circuit voltages have stabilized after power is applied.

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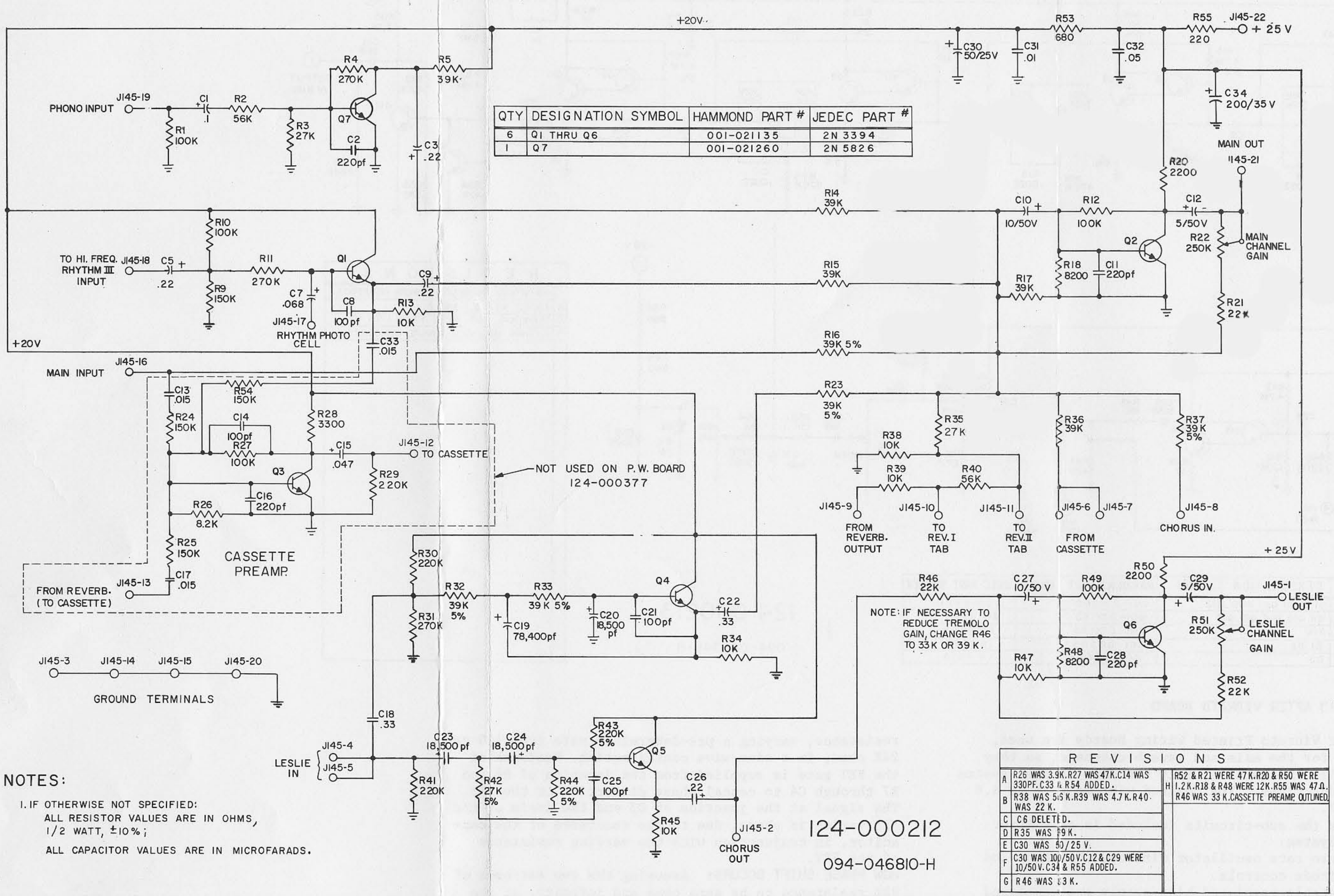
FIGURE 3-26
AFTER VIBRATO BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000213)



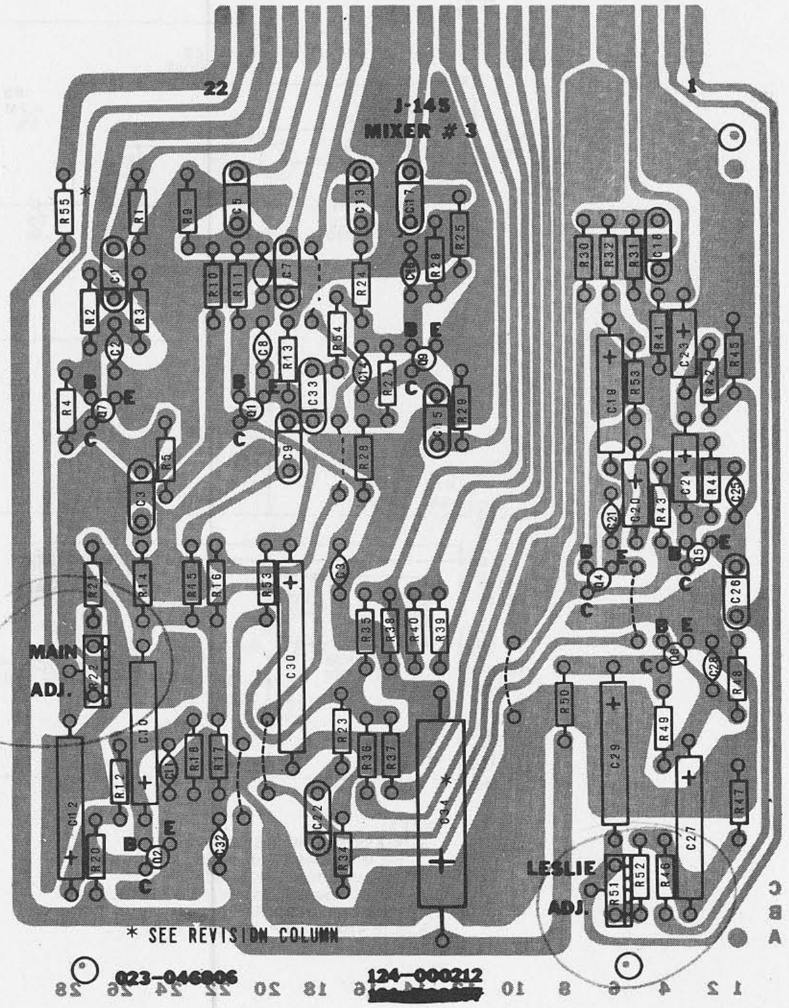
QTY	DESIGNATION SYMBOL	HAMMOND PART #	JEDEC PART #
6	Q1 THRU Q6	001-021135	2N 3394
1	Q7	001-021260	2N 5826

NOTES:

1. IF OTHERWISE NOT SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10%;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

REVISIONS

A	R26 WAS 3.9K. R27 WAS 47K. C14 WAS 330PF. C33 & R54 ADDED.
B	R38 WAS 5.6 K. R39 WAS 4.7 K. R40 WAS 22 K.
C	C6 DELETED.
D	R35 WAS 39 K.
E	C30 WAS 50/25 V.
F	C30 WAS 100/50 V. C12 & C29 WERE 10/50 V. C34 & R55 ADDED.
G	R46 WAS 33 K.
H	R52 & R21 WERE 47 K. R20 & R50 WERE 1.2 K. R18 & R48 WERE 12K. R55 WAS 47 Ω. R46 WAS 33 K. CASSETTE PREAMP. OUTLINED.



MIXER #3 BOARD (124-000212)

This assembly provides cassette mixing, phono preamplification, acoustic tremolo crossover filtering, expression pedal contouring. (for rhythm white noise voices.) a chorus input, and final mixing before main and tremolo power amplifiers. Single stage mixer preamps, (Q3 and Q7) are used for phono and cassette inputs at J-145-19 and 13. Q1 supplies contouring for Rhythm III white noise voices. (input at J-145-18) Q4 and Q5 are low and high pass filters for the tremolo channel whose input is at J-145-4. Because final tremolo signals are acoustic and cannot be recorded directly, animation of recorded signals is accomplished by routing tremolo channel through the reverb after vibrato (124-000213) via J-145-5, then back to mixer #3 via J-145-13 where it is coupled by R25, R26 and C16 to the base of amplifier Q3 and proceeds to cassette input from J-145-12. If desired, reverb must be added to recorder playback signal. R22 controls output gain of summing amplifier Q2, final mixer for the main channel, at J-145-21. The tremolo channel output is at J-145-1, and the gain of the summing amp for this channel (Q6) is regulated by R51. C34 and R55 make up a +25 V decoupling filter which reduces turn on thump. Input impedance of the phono preamp is 50 K ohms and an input of 250 mv drives the main power amp to an output of 35 watts R. M. S.

NOTE: Decoupling filter R55-C34 is not used on earlier versions of this assembly.

22

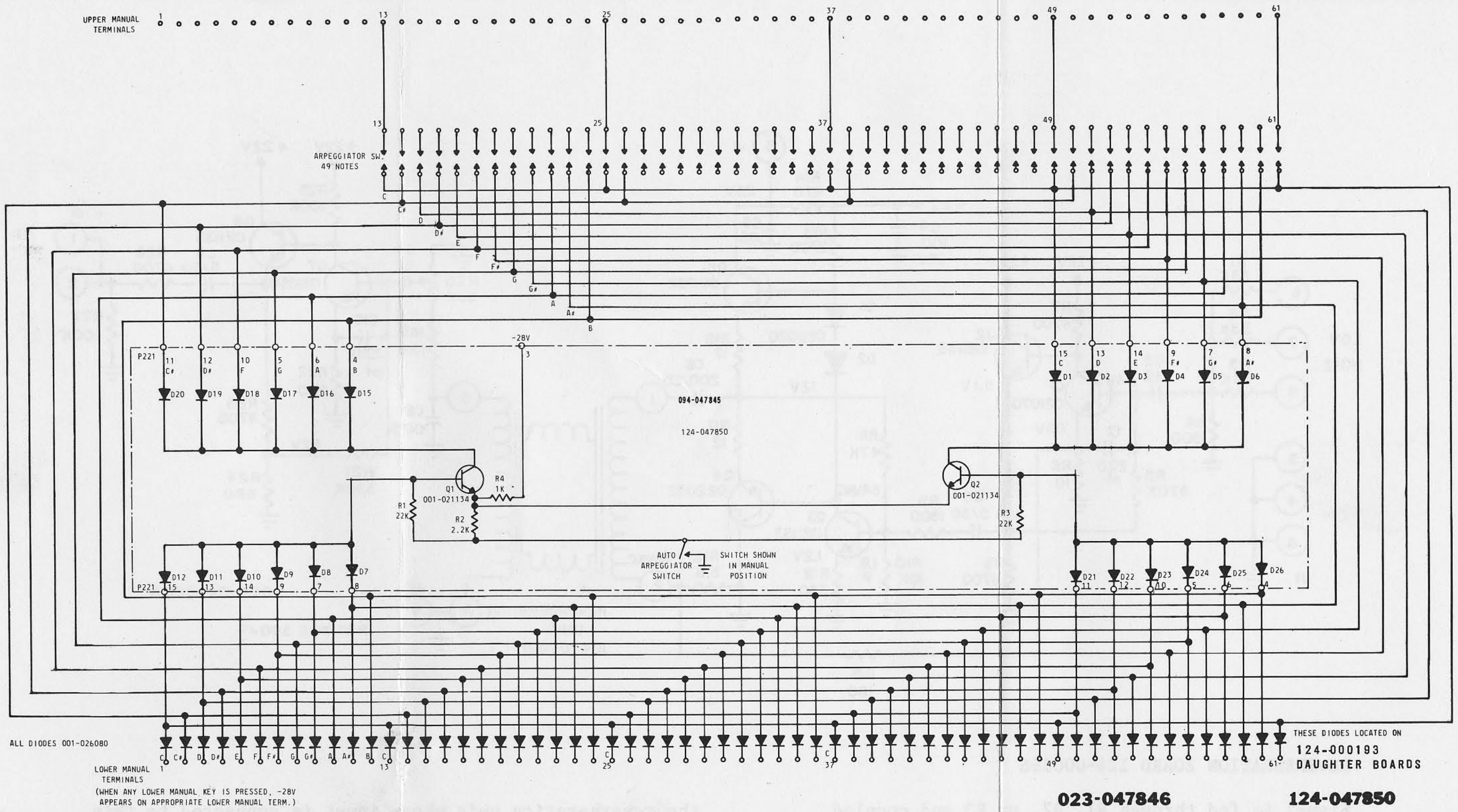
FIGURE 3-27
MIXER BOARD #3
SCHEMATIC LAYOUT AND THEORY
(124-000212)

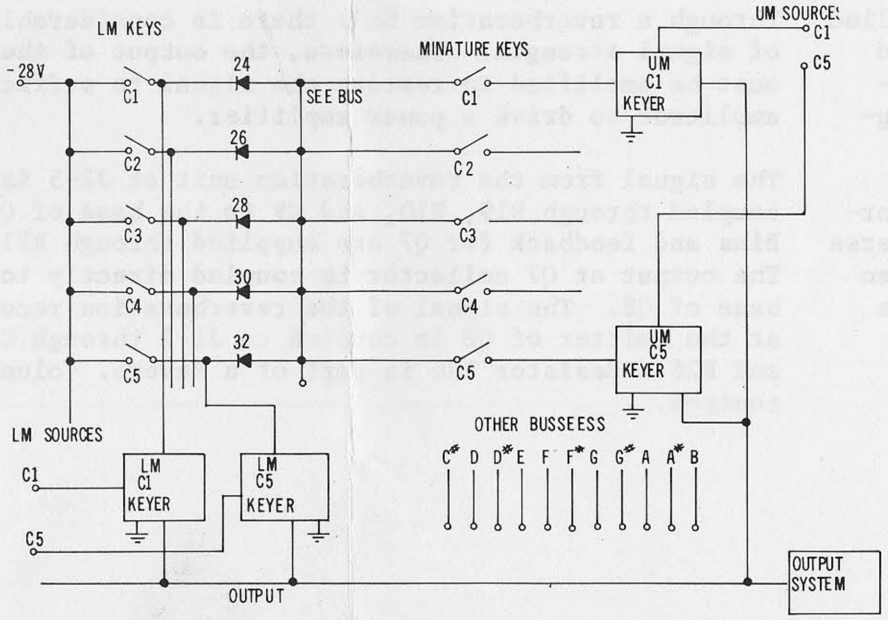
124-047850 ARPEGGIATOR BOARD

An electronic system for producing an Arpeggio, Glissando, or whole tone scale as desired, by stroking a miniature keyboard under a mylar strip located between the manuals. Next to the strip is a switch that selects between MANUAL and AUTOMATIC modes. In the MANUAL mode, ground is disconnected from Q1 and Q2, through R2 and R3. The keys depressed on the lower manual determine which notes registered on the upper manual will be heard, including those in octave relation thereto. If no lower manual keys are activated, the Arpeggiator strip is dead. Twelve circuits are used, one for each note of the scale. Diodes D24 thru D32 activate the "C" buss whenever a "C" note is keyed on the lower manual while providing isolation between the lower manual keyers, similarly, the "C#", "D", "D#", etc., busses will activate when these notes are played. Keying a buss will apply voltage on all octaves of that note on the Arpeggiator switches. Now if the Apreggiator is stroked, all octaves of the notes held on the lower manual will sound in succession as if they had been played on the upper manual, due to the connection of the Arpeggiator switches to the upper manual keyers.

OPERATING IN AUTOMATIC MODE:

Q1 and Q2 are normally turned on by grounding their bases through R2 and R3, supplying -18V to all keying busses from the emitters through the collectors and diodes D1 through D6 and D15 through D20. (When no keys are depressed on the lower manual). This activates all busses at slightly less than full keying voltage. When the Arpeggiator strip is stroked, all notes play in succession (GLISSANDO). If notes in the SAME whole tone scale are depressed, -28V will be applied to the base of the associated transistor, turning it off and removing the -18V from the busses for the other whole tone scale. Only the proper whole tone scale, in tune with notes depressed, will play. If a chord is keyed on the lower manual that has notes in BOTH whole tone scales, busses are activated with -28V on left and right sides, reverse biasing both transistors so only the busses for the notes depressed on the lower manual are activated. Consequently, only corresponding notes on the Arpeggiator become playable. Therefore, when the miniature keyboard is stroked, a Glissando occurs if no lower manual keys are depressed, and an Arpeggio is heard if one or more keys are held, but always in harmony with those keys.





KEYING SCHEMATIC

023-047846 124-047850

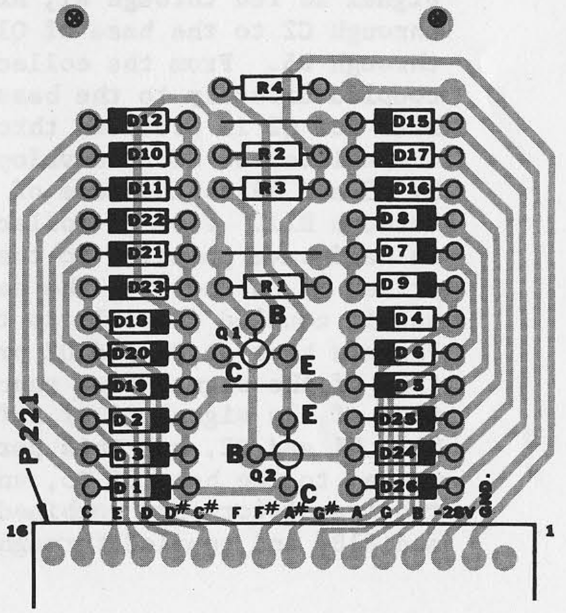
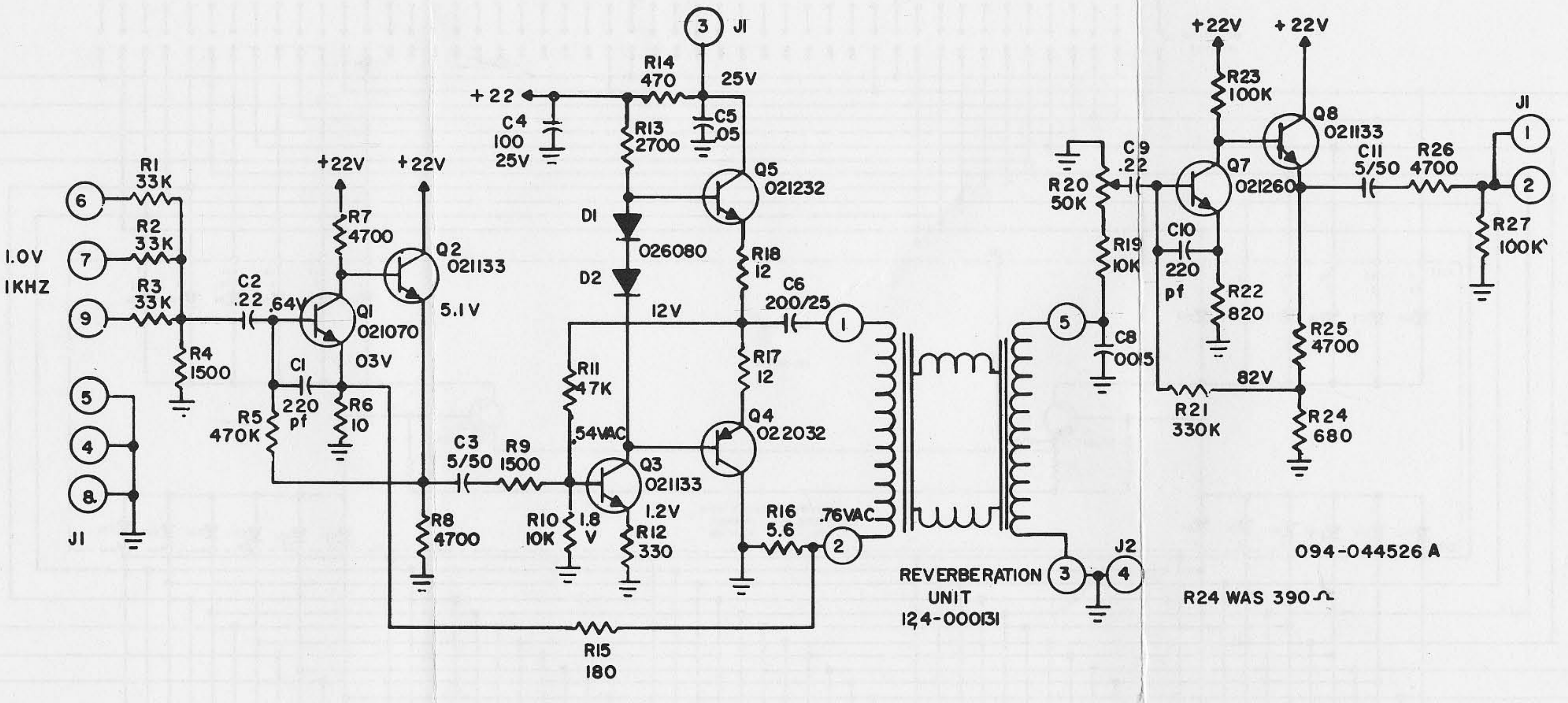
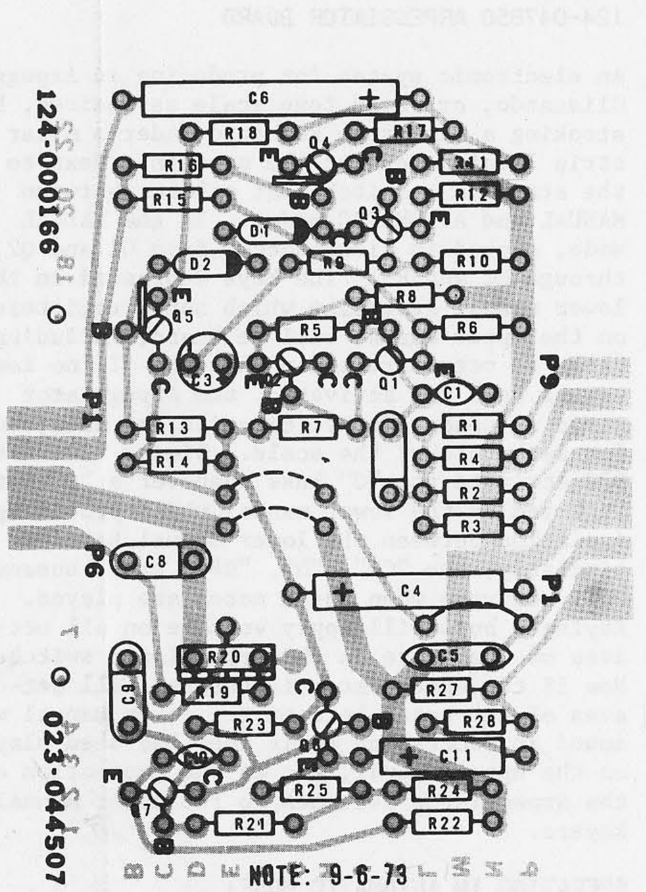


FIGURE 3-28
ARPEGGIATOR BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-047850)

23





NOTE: 9-6-73
C-4 WAS RELOCATED

REVERBERATION BOARD 124-000166

Signal is fed through R1, R2, or R3 and coupled through C2 to the base of Q1. Bias for Q1 is supplied through R5. From the collector of Q1, the signal is coupled directly to the base of emitter follower Q2. Bias for Q2 is provided through R7. The signal from the emitter of Q2 is developed across R8 and coupled by C3 and R9 to the base of Q3. Bias for Q3 is supplied through R11. From Q3 collector the signal is coupled in half-wave position to the push-pull amplifier comprised of Q4 and Q5. The negative portion of the signal is coupled directly to the base of Q4, a PNP. Forward bias on D1 and D2 prevents the negative portion of the signal from reaching Q5. The positive portion of the signal is of sufficient amplitude to reverse bias D1 and D2, and this portion of the signal is then passed to the base of Q5, an NPN. The outputs of the two transistors are combined at the junction of R17 and R18, and coupled through C6 and J2-1, to drive the reverberation unit whose input is connected to this point. Negative degenerative feedback is taken from R16, and connected through R15 to the emitter of Q1.

REVERBERATION RECOVERY

Through a reverberation unit there is considerable loss of signal strength. Therefore, the output of the unit must be amplified to restore the signal to sufficient amplitude to drive a power amplifier.

The signal from the reverberation unit at J2-5 is coupled through R19, R20, and C9 to the base of Q7. Bias and feedback for Q7 are supplied through R21. The output at Q7 collector is coupled directly to the base of Q8. The signal of the reverberation recovery at the emitter of Q8 is coupled to J1-1 through C11 and R26. Resistor R26 is part of a Reverb. Volume control.

FIGURE 3-29
REVERBERATION BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-047850)

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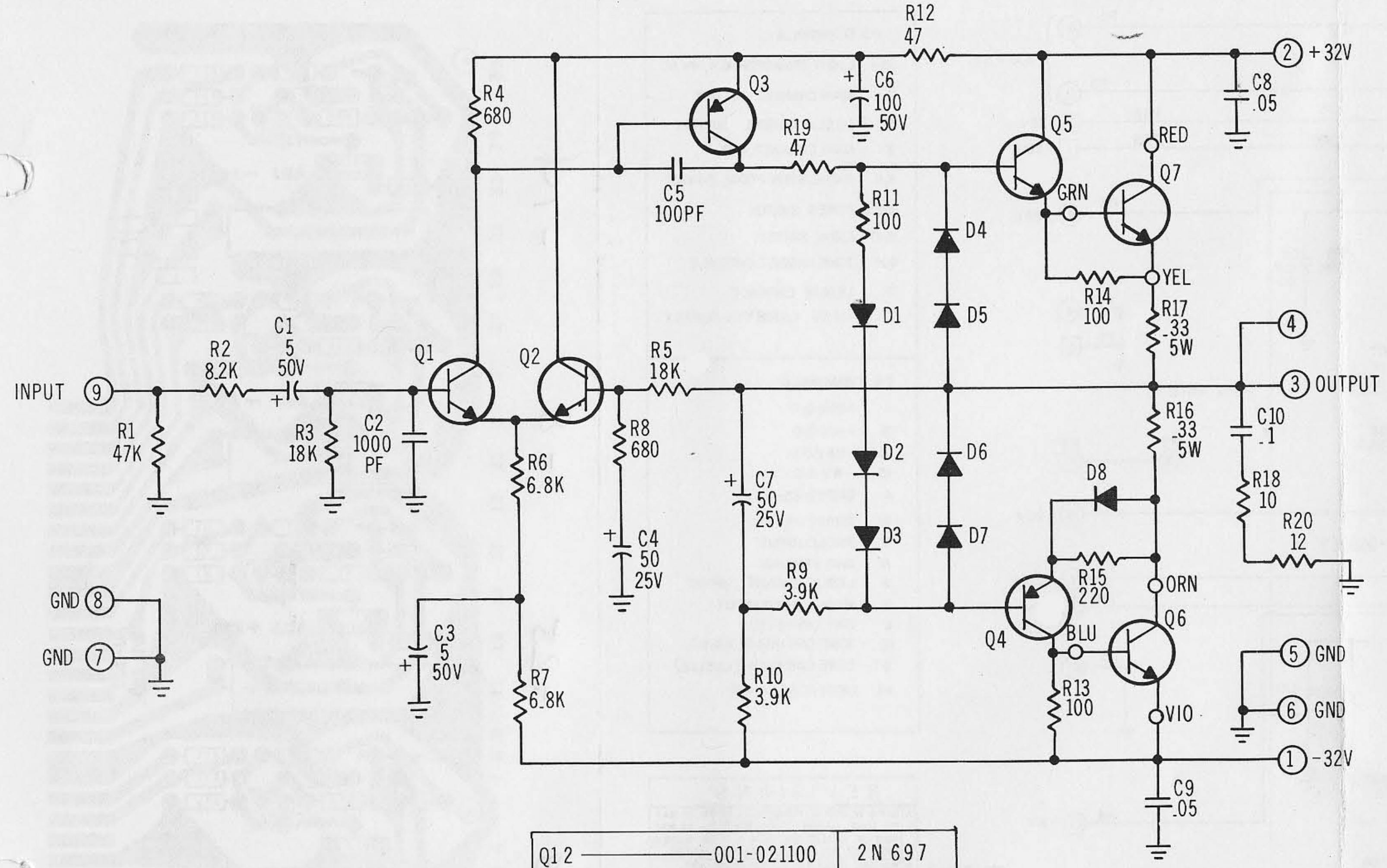
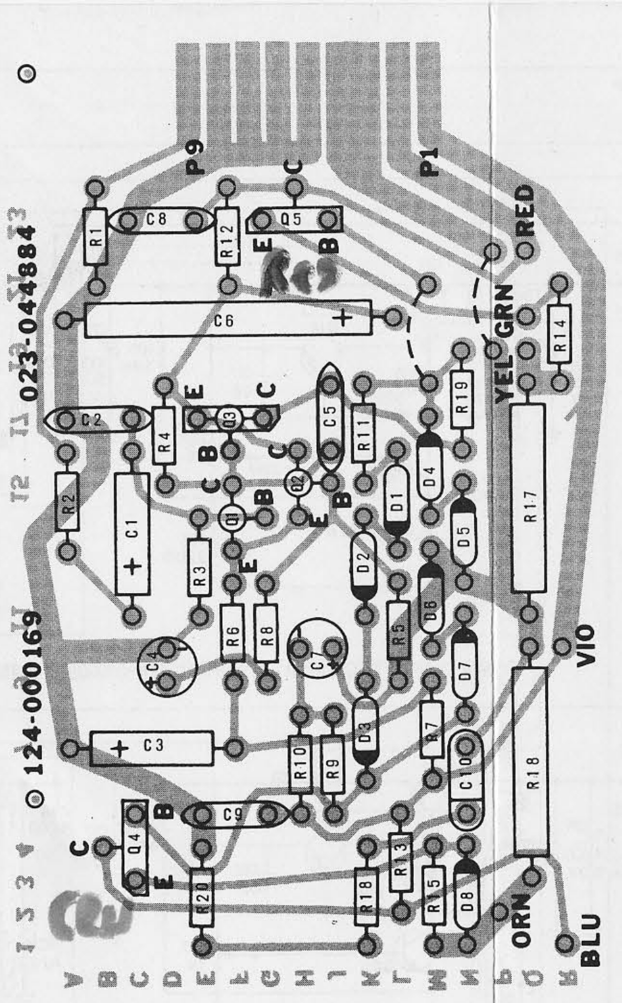


Q1 2	001-021100	2N 697
Q3	001-022040	MOT 4000
Q4	001-022050	D 43 C 8
Q5	001-021240	D 4 2 6 8
Q6 7	001-021270	2 N 3 0 5 5
D1 THRU 8	001-026080	1 N 4 1 4 8

124-000169
094-044907-B



35 WATT POWER AMP MODULE

A differential amplifier used for the input circuit keeps the output at D.C. ground by compensating the bias of the output transistors. This circuit makes quasi-complementary output practical by eliminating the bias problems. Transistors Q1 and Q2 are biased equally to ground with R3 and R5. Since the load is connected to the base of Q2 through R5, ground potential is achieved at the load.

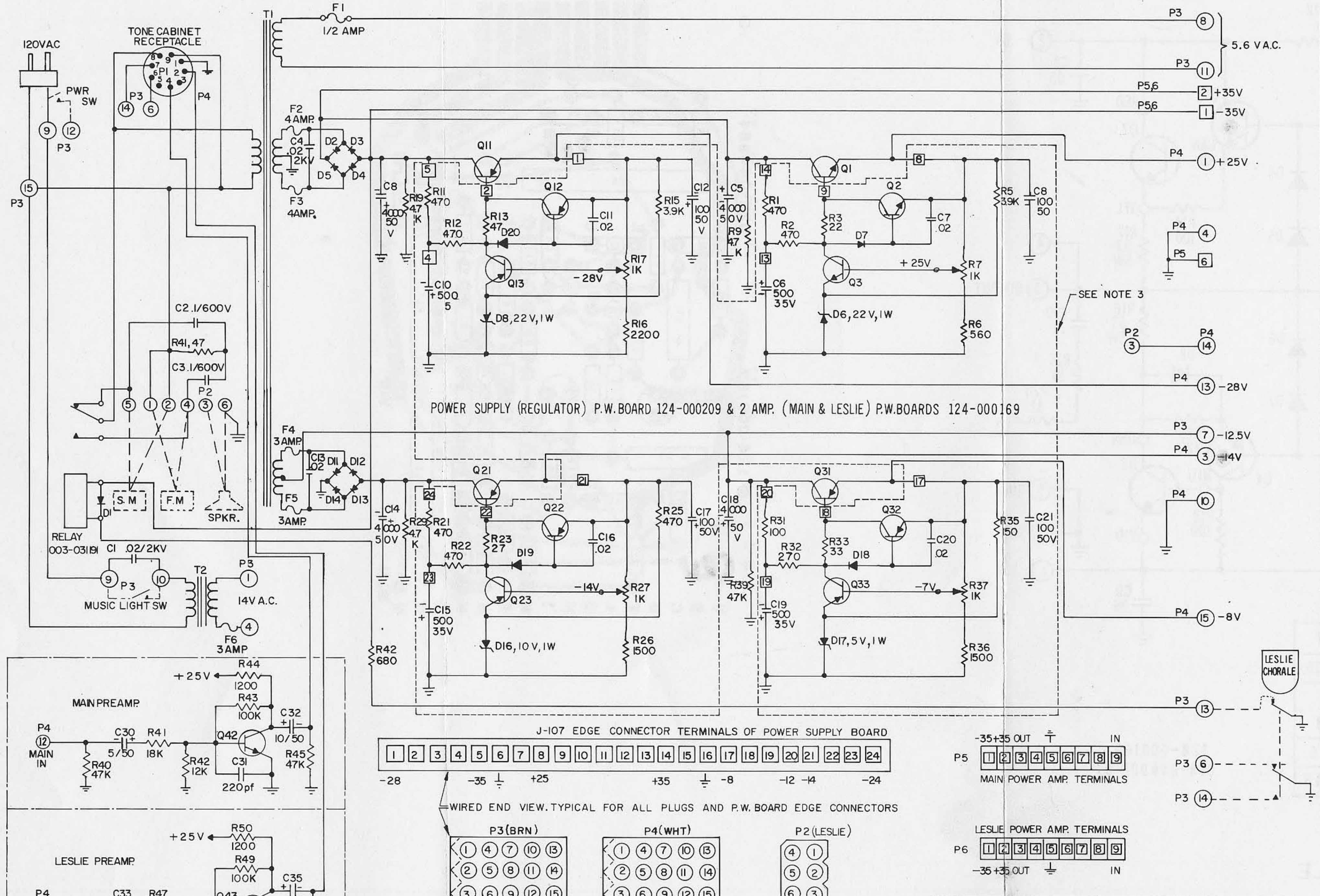
The D.C. feedback path from the load to the base of Q2 also presents a convenient way to apply A.C. feedback. The amount of feedback is controlled by R8 and R5 and their ratio determines the overall gain of the amplifier. The high open loop gain, which permits the large negative feedback, is due to transistor Q3 which operates class A with its emitter at A.C. ground. This means that Q3 must withstand the total voltage across the amplifier.

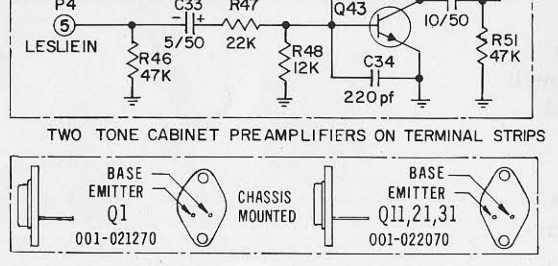
Three diodes, D1, D2, and D3, represent part of the load seen by Q3 and perform the important function of biasing the output transistors. In order for Q6 and Q7 to be biased on, the voltage drops across D1, D2, and D3 must equal the voltage drops across the emitters Q4, Q5, and Q7 plus the drops across D8, R16, and R17. The current through the three series diodes is determined by R9, and R10, and this current, in turn, determines the voltage drop across the diodes. A Q6, Q7 quiescent current of approximately 40 Ma is necessary to prevent crossover distortion.

Transistors Q5 and Q7 are NPN Darlington connected, while Q4 and Q6 act like a PNP Darlington connection. Resistor R15 and D8 causes the overall transconductance of Q4 and Q6 to be nearly the same as that of Q5 and Q7 thereby improving the linearity of the output stage. A bootstrap capacitor C7 is connected between R9 and R10 enabling Q6 to be driven into saturation. Without the positive feedback path through C7, there is insufficient drive to Q6 for symmetrical output.

RC pad R18, and C10 across the load provides high frequency stabilization. Short-circuit protection is accomplished during the positive cycle by series-connected diodes D1 to D6, in parallel with Q4 and Q5 emitters and R17. The diodes shunt the drive to Q7 and clamp its collector current at a level just above the normal peak load current. The collector current of Q6 is clamped during the negative cycle in the same manner as that of Q7 with diodes D5 and D3.

FIGURE 3-30
35 WATT AMP BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000169)

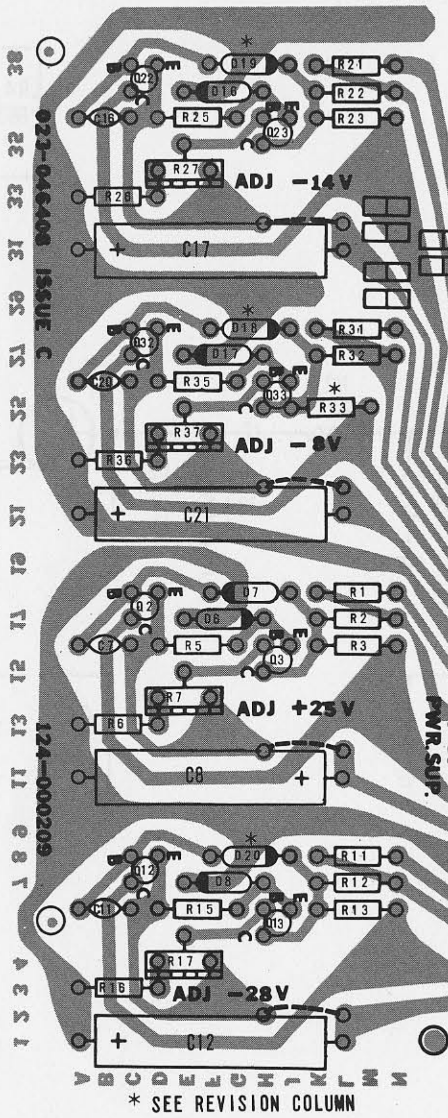




P3 TERMINALS:	
1&4	LIGHT TRANSFORMER, 14V AC
2	MAIN CHANNEL OUTPUT
5	LESLIE CHANNEL OUTPUT
3	MAIN SPEAKER GND
8,11	EXPRESSION PEDAL 5.6 V.A.C
9,12,15	POWER SWITCH
9,10	LIGHT SWITCH
6,14	TONE CABINET CHORALE
13	LESLIE CHORALE
7	-12.5V CASSETTE SUPPLY

P4 TERMINALS:	
1	+25V D.C
3	-14V D.C
13	-28V D.C
15	-8V D.C
4	GNDS(+25,-28V)
10	GNDS(-14,-7V)
7	PHONO INPUT
8	GND (PHONO)
2	LESLIE CHANNEL INPUT
9	MAIN CHANNE INPUT
6	GND (INPUTS)
12	TONE CAB INPUT (MAIN)
5	TONE CAB INPUT (LESLIE)
14	LESLIE SPEAKER

REVISIONS	
A	IN P4 TERMINAL FUNCTIONS, TERM. 12 WAS TO TONE CABINET (LESLIE), TERM. 14 WAS GND OF LESLIE SPEAKER & TERM. 11, LESLIE SPEAKER, DELETED. Q2 WAS 001-021160.
B	R2 WAS 1200. R31 & R32 WERE 470. R34 WAS 330.
C	IN P4 TERM. FUNCTION, TERM. 5 WAS LESLIE & TERM. 12 WAS MAIN. ADDED MAIN & LESLIE PREAMPS W/ CONNECTIONS TO P1. Q11, Q21 & Q31 WERE 001-012050. Q1 WAS 001-021180. R6 WAS 4700. R12 & R22 WERE 1200. R23 WAS 56 Ω.
D	TERM. P4-5 WAS P4-12 & P4-12 WAS P4-5. Q42 & Q43 WERE 011-021135.
E	C6, C10, C15 & C19 WERE 25 V. LESLIE & CHORALE REPLACED WITH TREMOLO & CELESTE.
F	R23 WAS 33 Ω.
G	R32 WAS 390 Ω.
H	R32 WAS 330 Ω.



-14

-8

+25

-28

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10%;
   ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. SYMBOL ○ INDICATES PIN NOS. OF PLUGS AND
   SYMBOL □ INDICATES PIN NOS. OF P.W.B. EDGE CONNECTORS.
3. ALL COMPONENTS, LOCATED ON THE OUTSIDE OF DOTTED LINES, (INCLUDING TWO TONE CABINET PREAMPS) ARE CHASSIS MOUNTED.

124-000169 (2)
124-000209
094-046414-H

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
1	Q1	001-021270	2N 3055
3	Q2, Q42, Q43	001-021260	2N 5826
1	Q3	001-021133	2N 3394
4	Q12, Q13, Q22, Q23	001-021172	2N 4249
3	Q11, Q21, Q31	001-022070	2N 4904
5	D1, D11, D12, D13, D14	001-024051	IN 4002
4	D2, D3, D4, D5	001-024061	IN 4720
2	D6, D8 - ZENER	001-023031	IN 3028
4	D7, D18, D19, D20	001-026080	IN4648
1	D16 - ZENER	001-023035	IN 4740
1	D17 - ZENER	001-023030	IN 4733

FIGURE 3-31
POWER SUPPLY BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000209)

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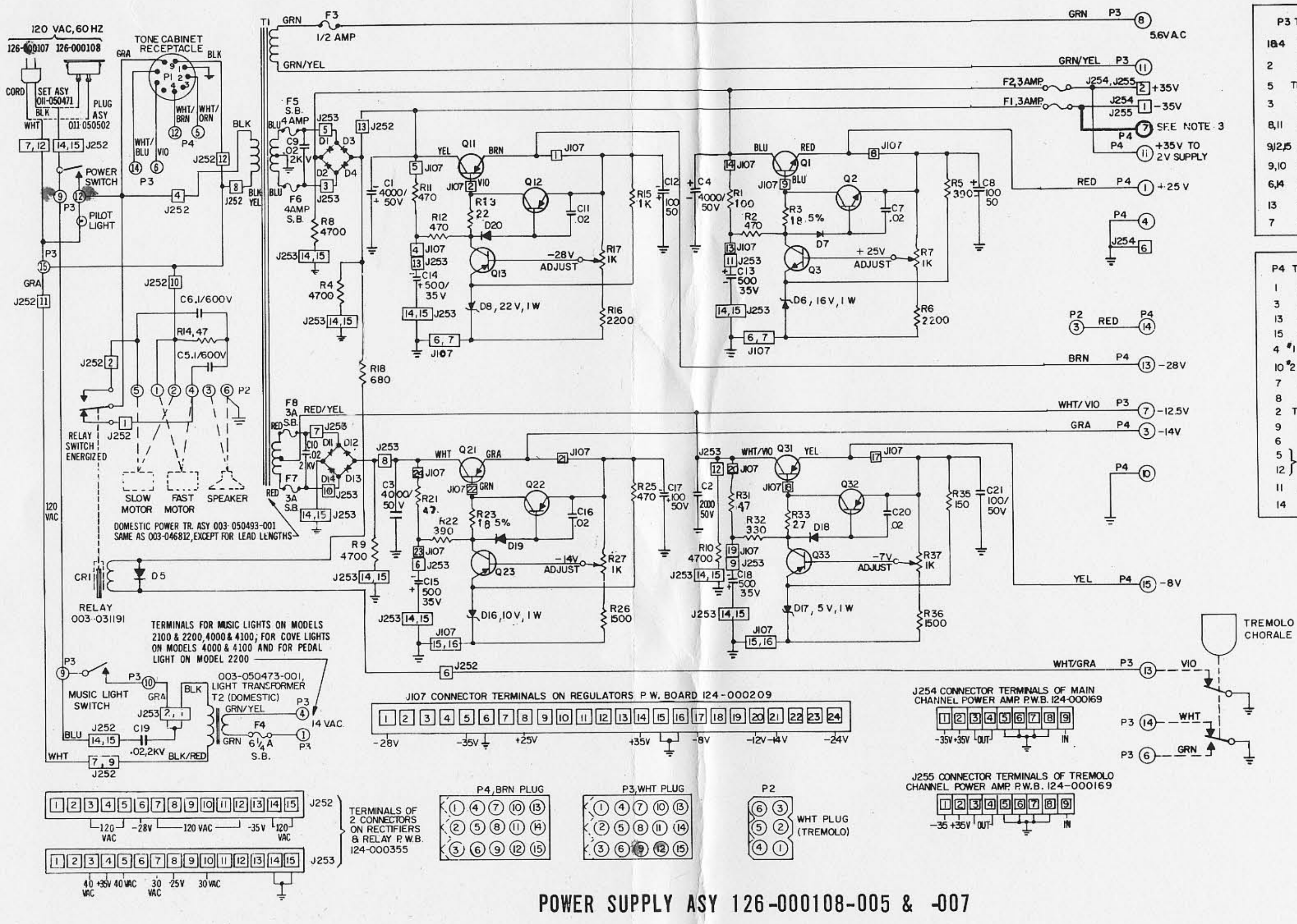
124-000209 POWER SUPPLY REGULATOR BOARD

For the regulation and short-circuit protection of four (4) power supply circuits, (+25V, -14V, -28V and -8V) Zeners D6, D8, D16 and D17 supply reference voltage, potentiometers R7, R17, R27 and R37 are voltage adjustment controls for setting the base voltage of power transistors Q1, Q11, Q21, and Q31, thus setting output (emitter) voltage. When the output load increases, the base voltage drops on regulating transistors, Q3, Q13, Q23, and Q33, allowing their collector voltage to become more negative as well as the base of the power transistors, bringing them closer to saturation and restoring output (emitter) voltage. If a short or similar condition is present, emitters of protection transistors Q2, Q22, and Q32 are grounded or brought near ground which in turn grounds the base terminals of the power transistors, turning off supply. Base resistors and diodes set the point at which protection transistors turn off.

ON/OFF
WHITE PLUG P-3
PIN 9, 12

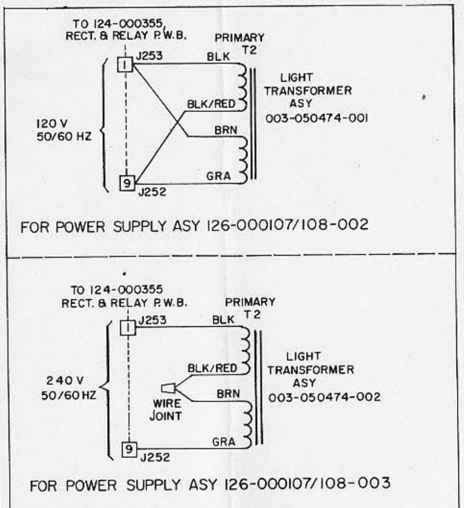


POWER SUPPLY ASY 126-000108-005 & -007

094-050625-E

P3 TERMINAL	FUNCTIONS
1&4	COVE LIGHT & MUSIC LIGHT (SEE NOTATION AT T2)
2	MAIN CHANNEL OUTPUT
5	TREMOLO CHANNEL OUTPUT
3	MAIN SPEAKER GND
8,11	EXPRESSION PEDAL 5.6 VA.C
9,12,15	POWER SWITCH
9,10	LIGHT SWITCH
6,14	TONE CABINET CHORALE
13	TREMOLO RELAY
7	-12.5V CASSETTE SUPPLY

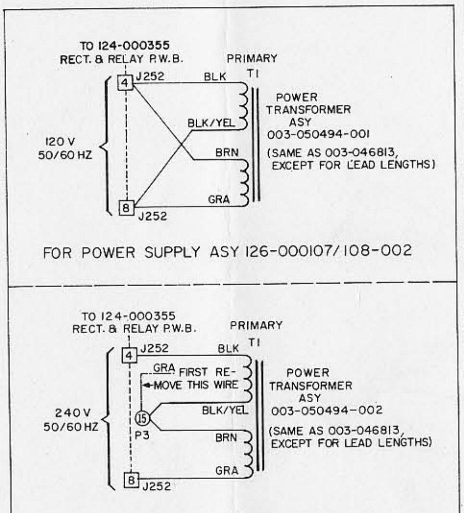
P4 TERMINAL	FUNCTIONS
1	+25V D.C
3	-14V D.C
13	-28V D.C
15	-8V D.C
4	#1 GNDS(+25,-28V)
10	#2 GNDS(-14,-7V)
7	PHONO INPUT
8	GND (PHONO)
2	TREMOLO CHANNEL INPUT
9	MAIN CHANNEL INPUT
6	GND (INPUTS)
5 12	TONE CABINET INPUTS
11	+ 35 V. D.C.
14	TREMOLO SPEAKER



FOR POWER SUPPLY ASY 126-000107/108-002

FOR POWER SUPPLY ASY 126-000107/108-003

LIGHT TRANSFORMER ASYS



FOR POWER SUPPLY ASY 126-000107/108-002

FOR POWER SUPPLY ASY 126-000107/108-003

POWER TRANSFORMER ASYS

PRIMARY CONNECTIONS OF TRANSFORMERS, USED IN POWER SUPPLY ASYS FOR EXPORT.

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10%;
ALL CAPACITOR VALUES ARE IN MICROFARADS;
ALL SWITCHES ARE IN "OFF" POSITION.

2. SYMBOL INDCATES:
"–②P3" PIN 2 IN PLUG P3;
"–3 J107" PIN 3 IN P.W. BOARD EDGE CONNECTOR J107.
"–14,15– J252" TWO (OR MORE) INTERCONNECTED PINS 14 AND 15 ON P.W. BOARD EDGE CONNECTOR J252.

3. ON 126-000108-005 & 007
P4-7 IS -35V AND P4-8 IS OPEN.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
1	Q1	001-021270	2N 3055
1	Q2	001-021260	2N 5826
1	Q3	001-021133	2N 3394
3	Q11, Q21, Q31	001-022070	2N 4904
6	Q12,Q13,Q22,Q23,Q32,Q33	001-021172	2N 4249
8	D1 THRU D4 & D11 THRU D14	001-024061	IN 4720
1	D5	001-024051	IN 4002
1	D6, ZENER, 16 V, 1W	001-023038	IN 4745
4	D7, D18, D19, D20	001-026080	IN 4148
1	D8, ZENER, 22 V, 1W	001-023031	IN 3028
1	D16, ZENER, 10 V, 1W	001-023035	IN 4740
1	D17, ZENER, 5 V, 1W	001-023030	IN 4733

REVISIONS	

FIGURE 3-31A
POWER SUPPLY ASSEMBLY
SCHEMATIC AND LAYOUT
(124-000209)

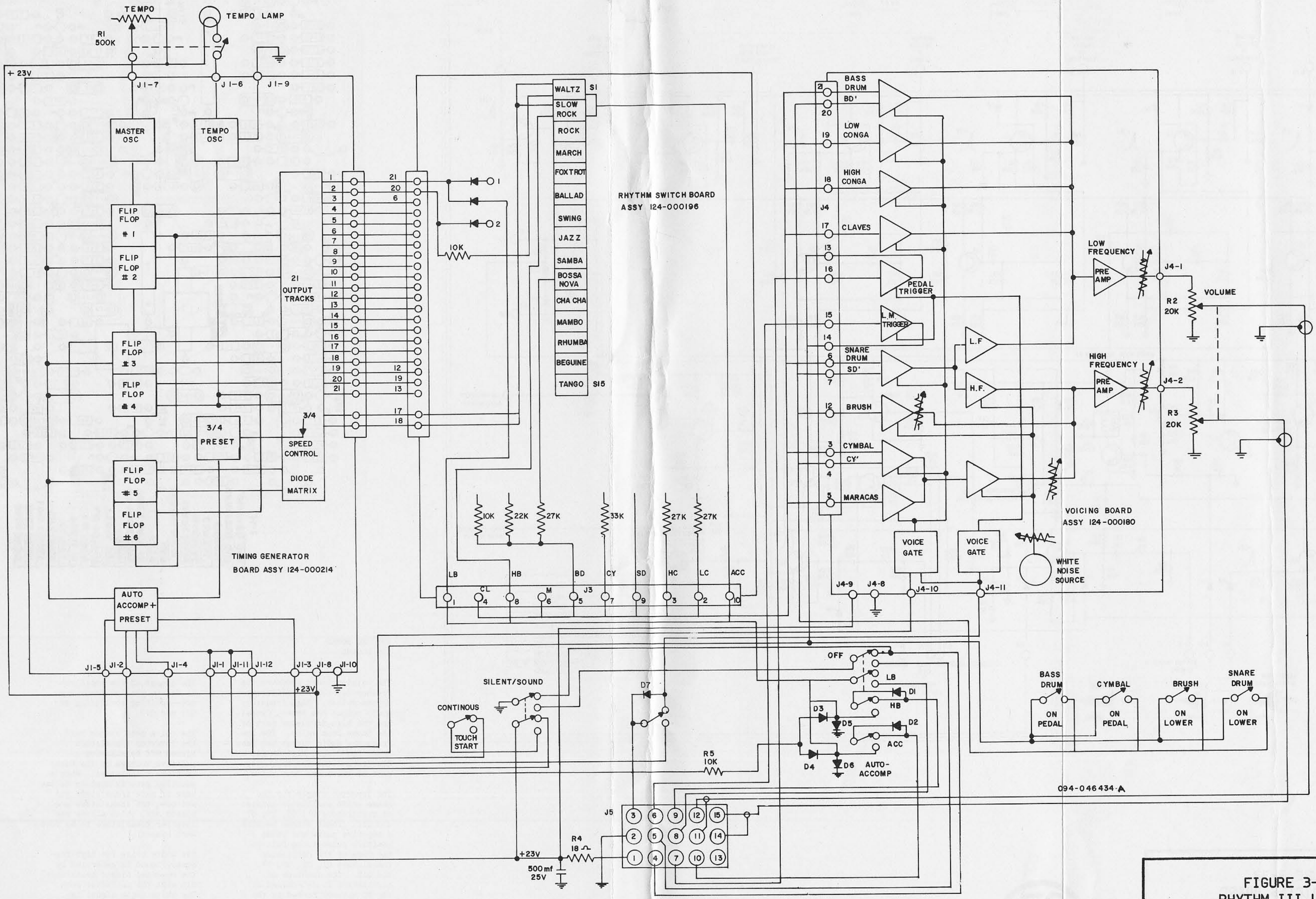
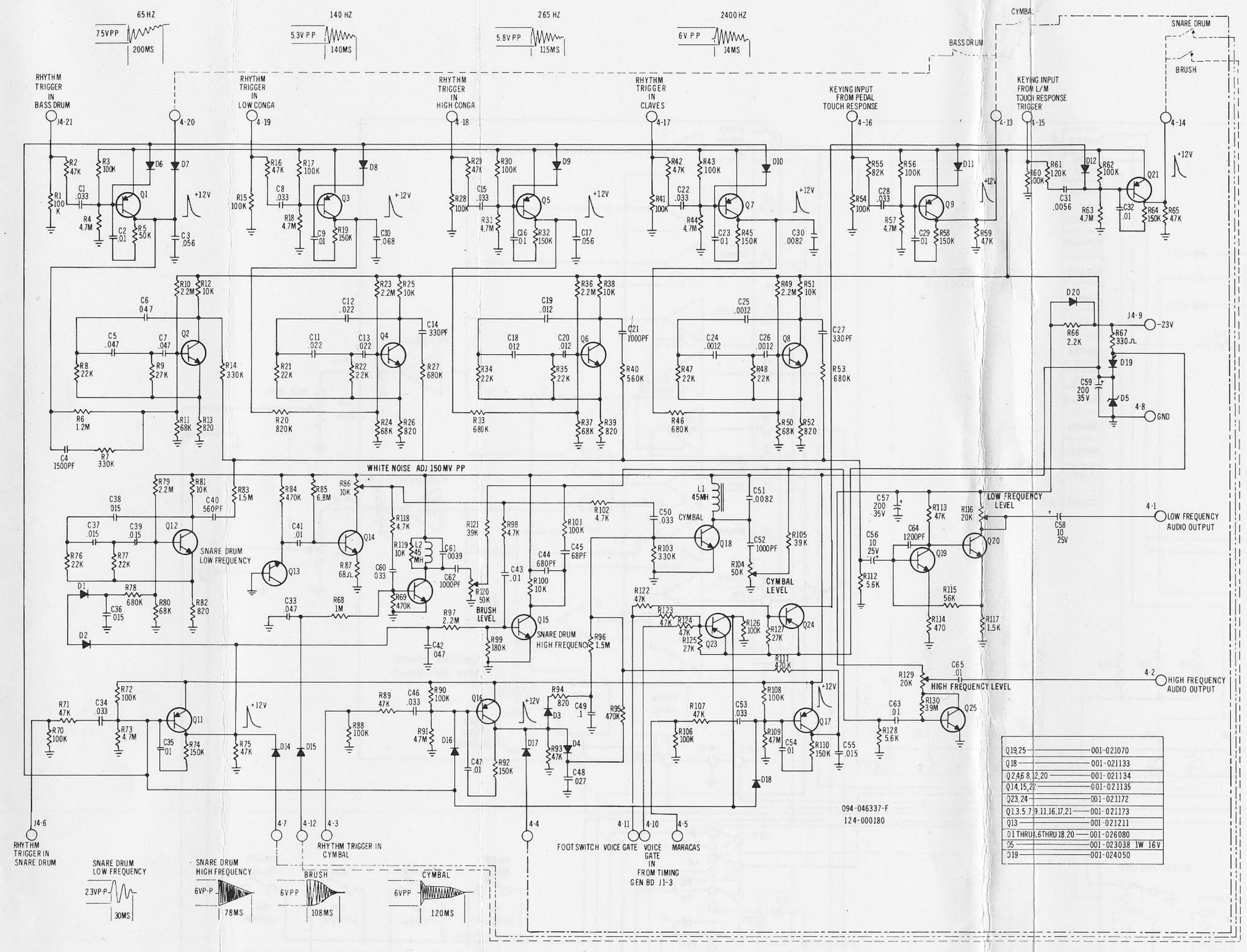
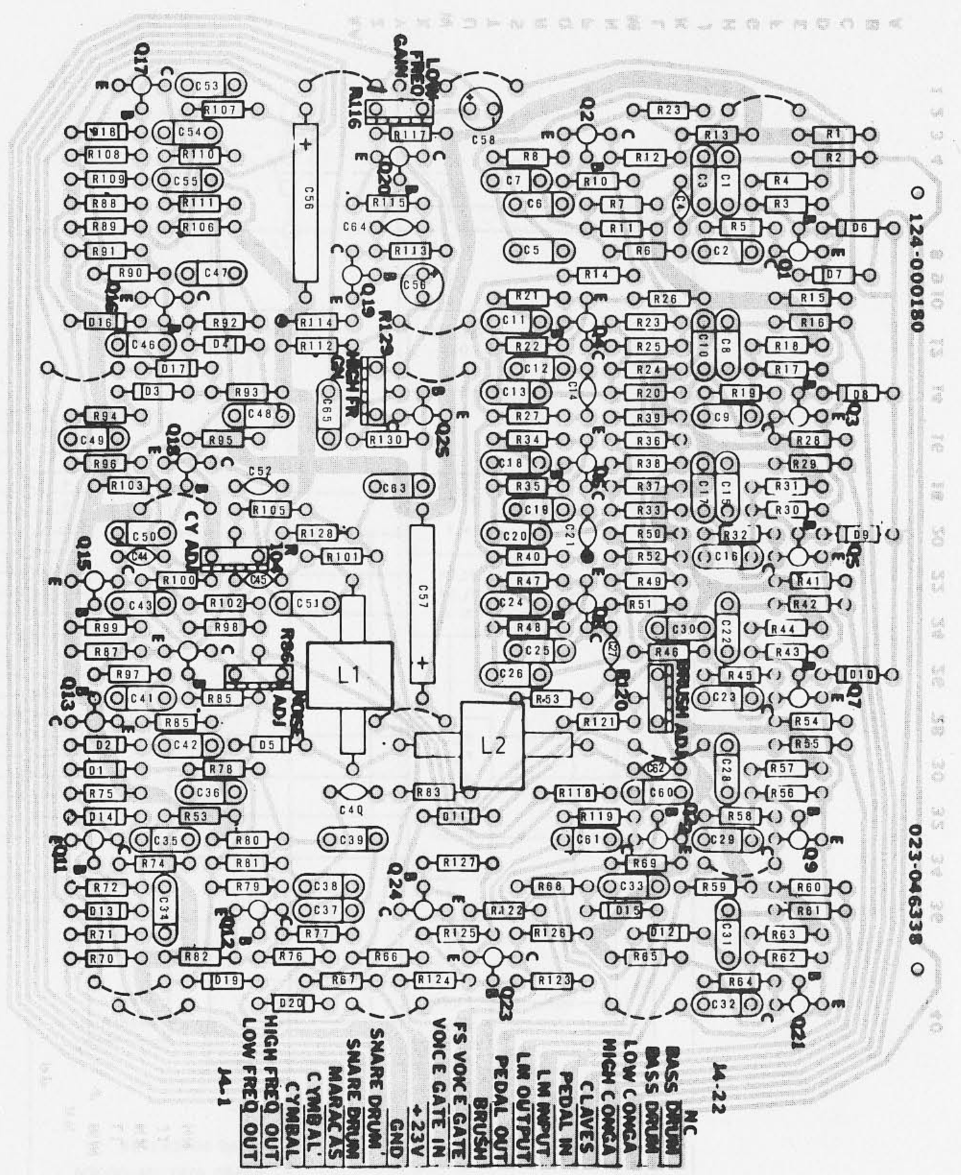


FIGURE 3-32
RHYTHM III LOGIC
DIAGRAM
(125-000082-001)



Q19,25	001-021070
Q18	001-021133
Q2,4,6 8,12,20	001-021134
Q14,15,22	001-021135
Q23,24	001-021172
Q1,3,5,7,9,11,16,17,21	001-021173
Q13	001-021211
D1 THRU 4,6THRU 18,20	001-026080
D5	001-023038 1W 16V
D19	001-024050



VOICING BOARD
124-000180

The voicing board produces the frequencies for the different rhythm voices. High frequency audio output has Brush, Cymbal, and the high frequency part of the Snare Drum voice. The low frequency audio output has Bass Drum, Low Conga, High Conga, Claves, and the low frequency part of the Snare Drum voice.

The inverter stages for the phase shift oscillator consist of transistors Q1, Q3, Q5, Q7 and Q11. These stages receive a negative pulse and cause a positive pulse to be felt on the base of the oscillator transistors Q1, Q2, Q6, Q8, and Q12. The duration of oscillation is determined by the RC network formed by the capacitors C3, C10, C17, C30 and the series resistance to the base of the transistor in the oscillator.

The output of the oscillator is fed to the low frequency pre-amplifier consisting of Q12 and Q20.

The voice gate stages hold the inverter transistors biased off by allowing a positive voltage on the bases of these transistors. When a positive gate is applied to the base of gate transistors Q23 and Q24, the transistors are biased off, which allows the inverter transistors to be foreward biased.

The white noise for high frequency sound is generated by the reversed biased transistor Q13 with the collector open. The white noise signal is amplified and fed through the potentiometer R86 to the cymbal amplifier, Q18. The tank circuit in the collector has a resonant frequency approximately the sound of a cymbal. The transistor is foreward biased by an inverter circuit, similar to the prior ones mentioned.

The Brush amplifier Q22 amplifies the white noise signal and this signal together with the cymbal signal is fed to the high frequency amplifier.

The Snare Drum circuit has an inverter stage and a phase shift oscillator. A variation from the other voices is the inverted input pulse is fed to two points; phase shift oscillator, and to the frequency muting circuit, consisting of transistor Q15 plus the RC network.

FIGURE 3-33
RHYTHM VOICING BOARD
SCHEMATIC, AND LAYOUT
(124-000180)

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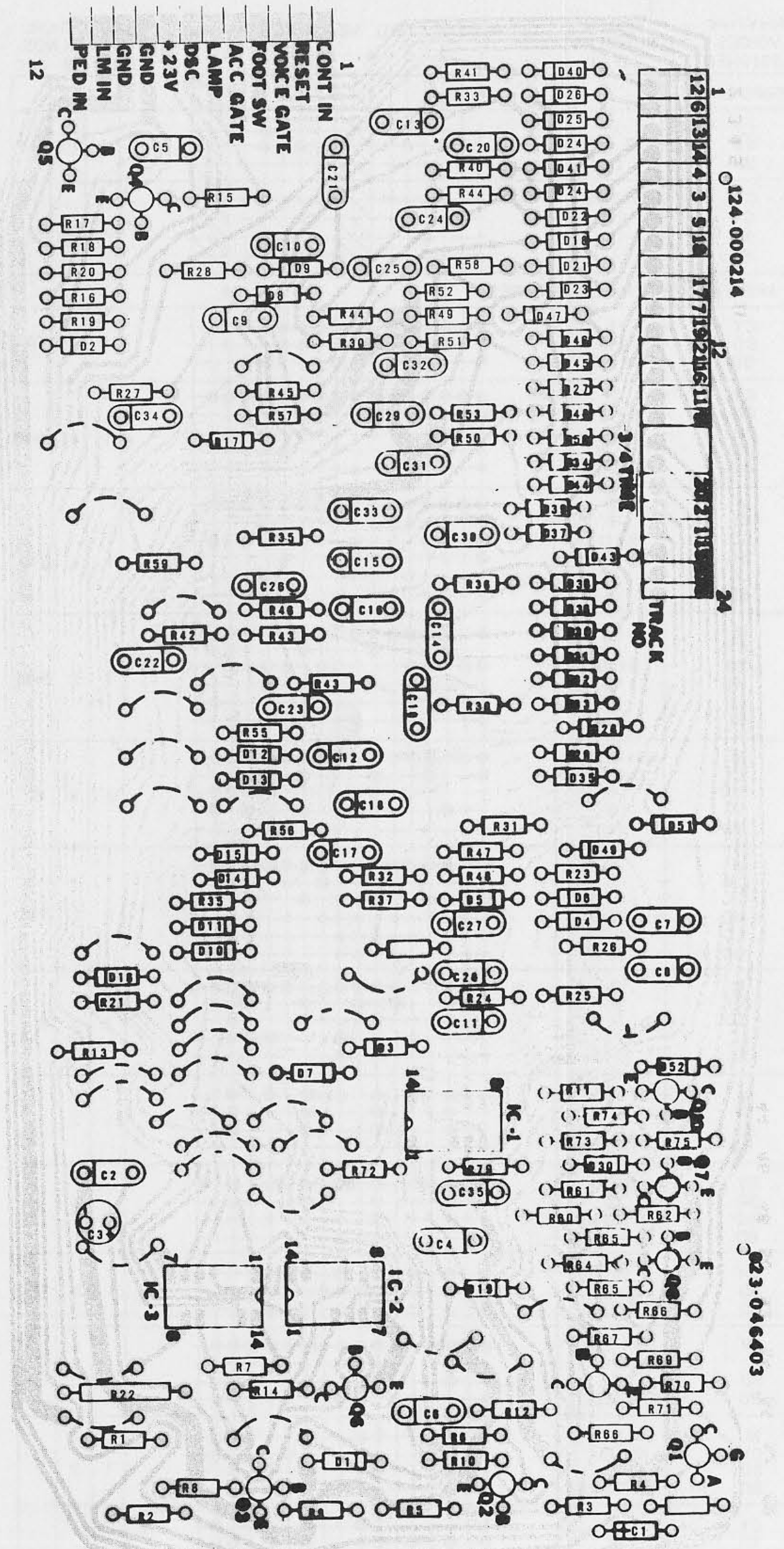

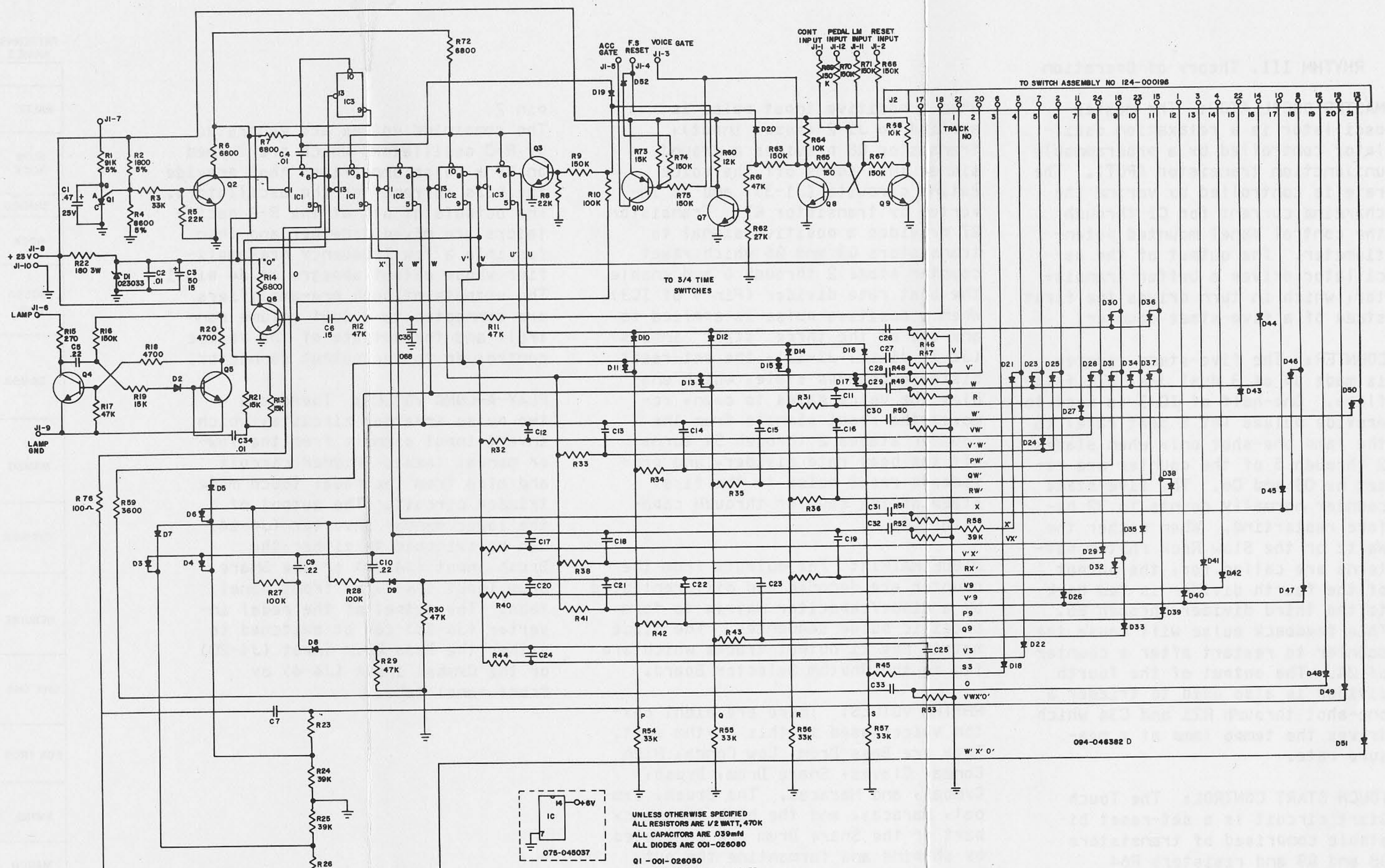

124-000214 RHYTHM III ASSEMBLY
TIMING GENERATOR BOARD

To regulate rhythm patterns and tempo, timing rates are geared to a relaxation oscillator controlled by a programmable uni-junction transistor (PUT). The rate is controlled by varying the charging current for C1 through the control panel pot. Oscillator output drives a buffer transistor which, in turn, drives a five stage counter made up of 3 dual J-K, DTL flip-flops. Half of IC-3 provides pulses at a beat rate to the lamp (one shot only) when stages 2 through 5 of the counter are reset by Q3 and Q6. The five stage counter normally accepts 32 pulses before restarting. When Waltz or Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will will cause the counter to restart after reaching 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 driving the tempo lamp at a measure rate.

A set, re-set bistable made up of Q8 and Q9 with resistors R64 through R71, is used for the Touch-Start circuit. Q8 provides voice gating signals for the voicing board (124-000180) and for generator gates controlled by Q7 and Q10. A positive pulse applied to the re-set input (J1-2) causes Q8 to provide a ground signal that turns off voice gating circuits, (J1-3) and is inverted by Q7. A positive signal is supplied by Q7 to Q3 and Q6, who, in turn, re-set stage 2 through 6 of the counter and the beat rate divider. (Pin 9 of IC-3). A positive pulse applied to any of the three "start" inputs, (J1-1, J1-11, J1-12) causes the bistable to change state, allowing the voice gates to open, removes the re-set signal from stages 2 through 6 of the counter, turns off the beat rate divider, and provides a re-set pulse to counter stage 1 through C4. The counter outputs are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences, the matrix has 21 output tracks which are fed to the Rhythm Selector Board. (124-000196).

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FIGURE 3-34
RHYTHM GENERATOR BOARD
SCHEMATIC, AND LAYOUT
(124-000214)

RHYTHM III. Theory of Operation

MASTER OSCILLATOR: The master oscillator is a relaxation oscillator controlled by a programmable unijunction transistor (PUT). The rate is controlled by varing the charging current for CI through the control panel mounted potentiometer. The output of the oscillator drives a buffer transistor, which in turn drives the first stage of a five-stage counter.

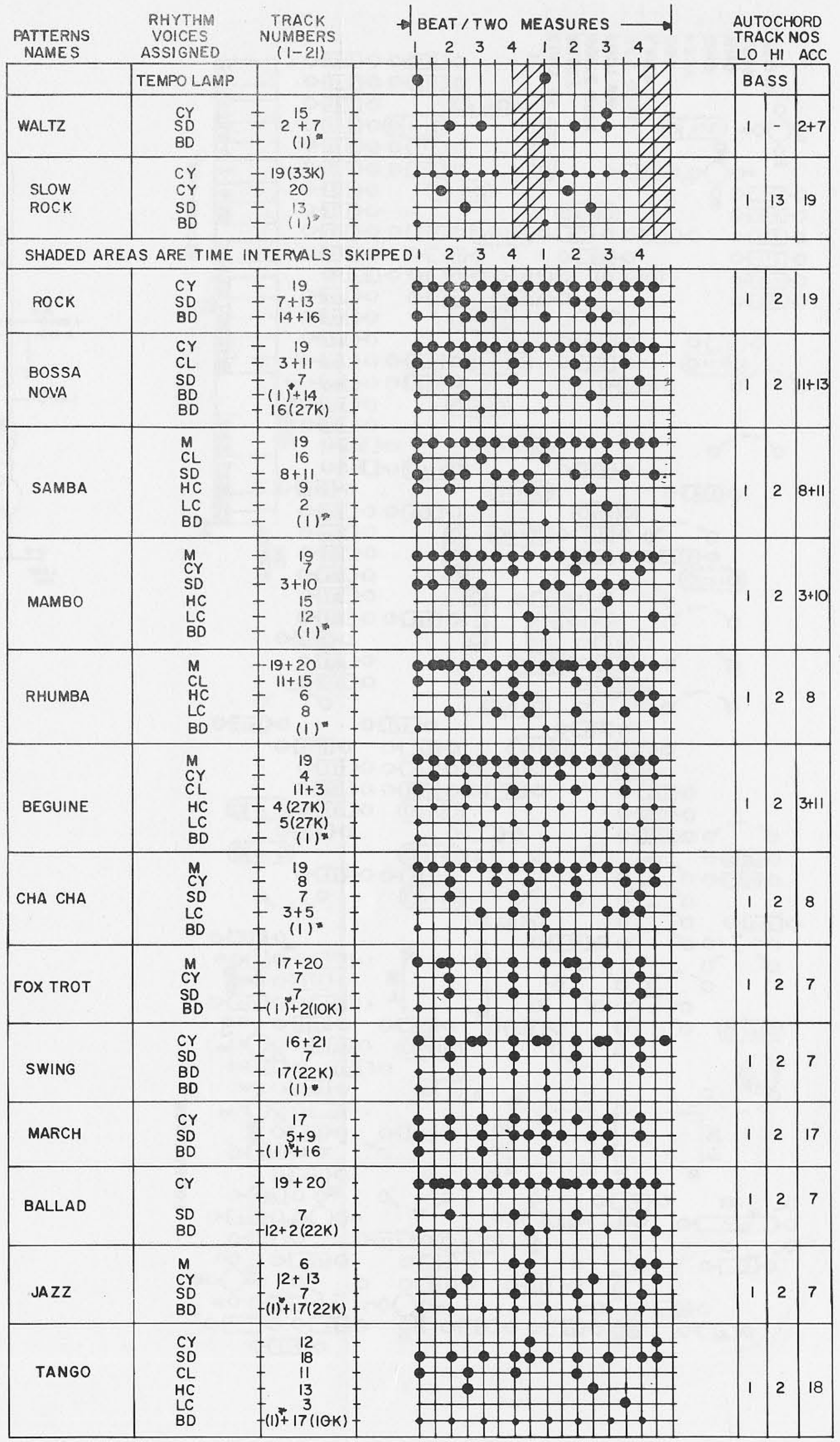
COUNTER: The five-stage counter is made up of 3 dual J-K, DTL flip-flops. One-half of IC 3 is used to provide pulses (at a beat rate) to the lamp one-shot only when stages 2 through 5 of the counter are reset by 03 and 06. The five-stage counter normally counts to 32 before restarting. When either the Waltz or the Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will cause the counter to restart after a counter of 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 which drives the tempo lamp at a measure rate.

TOUCH START CONTROL: The Touch Start circuit is a set-reset bistable comprised of transistors Q8 and Q9 and resistors R64 through R71. The output of transistor Q8 provides signals for voice gates on the Voicing Board (124-000180) and also for generator gating circuits controlled by transistors Q7 and Q10. When a positive input pulse is applied to J1-2 (reset input), transistor Q8 provides a ground signal that turns off the voice gating circuits (J1-3), and is inverted by transistor Q7. Transistor Q7 provides a positive signal to transistors Q3 and Q6 which reset counter stage 2 through 6 and enable the beat rate divider (Pin 9 of IC3). When a positive pulse is applied to any one of the three "start" inputs (J1-1, J1-11, J1-12), the set-reset bistable changes state, which enables the voice gates to open, removes the reset signals from the counter stages 2 through 5, turns off the beat rate divider, and provides a reset pulse to the first stage of the counter through capacitor C4.

DIODE MATRIX: The outputs from the counter are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences. The diode matrix has 21 output tracks which are fed to the Rhythm Selector Board.

RHYTHM VOICES: There are eight rhythm voices used in this rhythm unit. They are Bass Drum, Low Conga, High Conga, Claves, Snare Drum, Brush, Cymbal, and Maracas. The Brush, Cymbal, Maracas, and the high frequency part of the Snare Drum are generated by shaping and formanting the output of a white noise source. The white noise is generated by a reverse biased transistor. The outputs of the white noise voices are combined and fed to a high frequency pre-amplifier whose output appears on J4 pin 2.
The remaining voices are generated by R-C oscillators which are turned on by a pulse amplifiers that provide the bias current for the oscillators. The outputs of all of the R-C oscillators are mixed together and then fed into a low frequency pre-amplifier whose output appears on J4 pin 1. The outputs of both pre-amplifiers are connected to a dual volume control, and the outputs of the volume control go to the output connector.

PLAY-A-LONG VOICES: There are two pulse inverter circuits, which invert input signals from the lower manual legato trigger circuit and also from the pedal touch mode trigger circuit. The output of the lower manual inverter (J4-14) can be switched to either the Brush input (J4-14) or the Snare Drum input (J4-7) by front panel tabs. The output of the pedal inverter (J4-13) can be switched to either the Bass Drum input (J4-20) or the Cymbal input (J4-4) by front panel tabs.



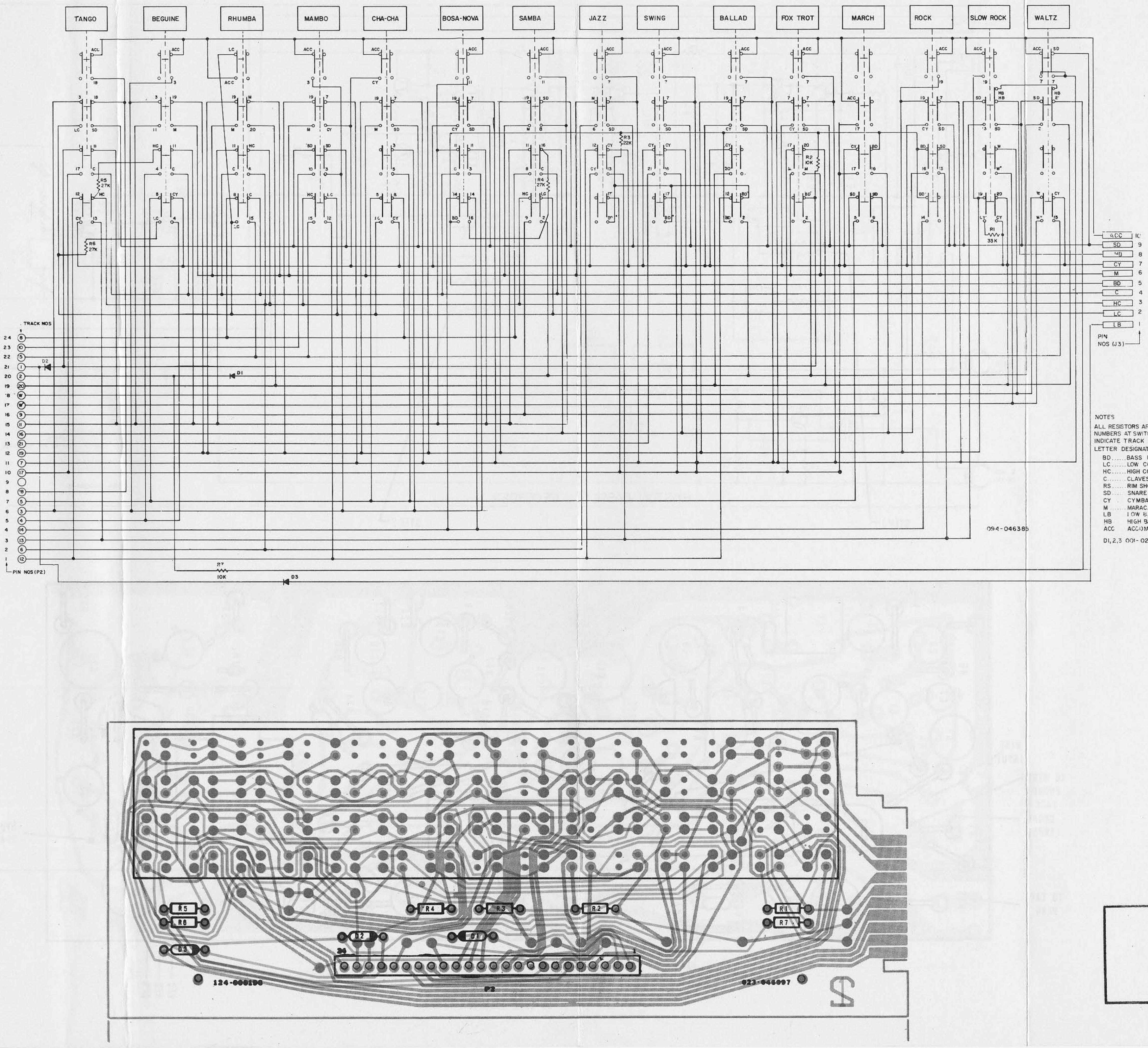
PATTERNS NAMES	RHYTHM VOICES ASSIGNED	TRACK NUMBERS (1-21)	AUTOCHORD TRACK NOS LO (BASS)	HI (BASS)	ACC
	TEMPO LAMP				
WALTZ	CY SD BD	15 2 + 7 (1)*	1	-	2+7
SLOW ROCK	CY CY SD BD	19(33K) 20 13 (1)*	1	13	19
ROCK	CY SD BD	19 7+13 14+16	1	2	19
BOSSA NOVA	CY CL SD BD BD	19 3+11 7 (1)*+14 16(27K)	1	2	11+13
SAMBA	M CL SD HC LC BD	19 16 8+11 9 2 (1)*	1	2	8+11
MAMBO	M CY SD HC LC BD	19 7 3+10 15 12 (1)*	1	2	3+10
RHUMBA	M CL HC LC BD	19+20 11+15 6 8 (1)*	1	2	8
BEGUINE	M CY CL HC LC BD	19 4 11+3 4(27K) 5(27K) (1)*	1	2	3+11
CHA CHA	M CY SD LC BD	19 8 7 3+5 (1)*	1	2	8
FOX TROT	M CY SD BD	17+20 7 7 (1)*+2(10K)	1	2	7
SWING	CY SD BD BD	16+21 7 17(22K) (1)*	1	2	7
MARCH	CY SD BD	17 5+9 (1)*+16	1	2	17
BALLAD	CY SD BD	19 + 20 7 12+2(22K)	1	2	7
JAZZ	M CY SD BD	6 12+13 7 (1)*+17(22K)	1	2	7
TANGO	CY SD CL HC LC BD	12 18 11 13 3 (1)*+17(10K)	1	2	18

HC — HIGH CONGA
LC — LOW CONGA
RS RIM SHOT
C — CLAVES
SD — SNARE DRUM
M — MARACAS
CY — CYMBAL
BD — BASS DRUM

Small Dots indicate attenuated loudness.

Bass Drum always connected to track 1 through 10K

FIGURE 3-35
RHYTHM III PATTERNS
CHART AND THEORY



NOTES
ALL RESISTORS ARE IN OHMS ± 10% 1/2W
NUMBERS AT SWITCH CONTACTS
INDICATE TRACK NO
LETTER DESIGNATIONS ARE

BD	BASS DRUM
LC	LOW CONGA
HC	HIGH CONGA
C	CLAVES
RS	RIM SHOT
SD	SNARE DRUM
CY	CYMBAL
M	MARACAS
LB	LOW BASS
HB	HIGH BASS
ACC	ACCOMPANIMENT

D1,2,3 001-026080

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FIGURE 3-36
RHYTHM SELECTOR BOARD
SCHEMATIC AND LAYOUT
(124-000196)